



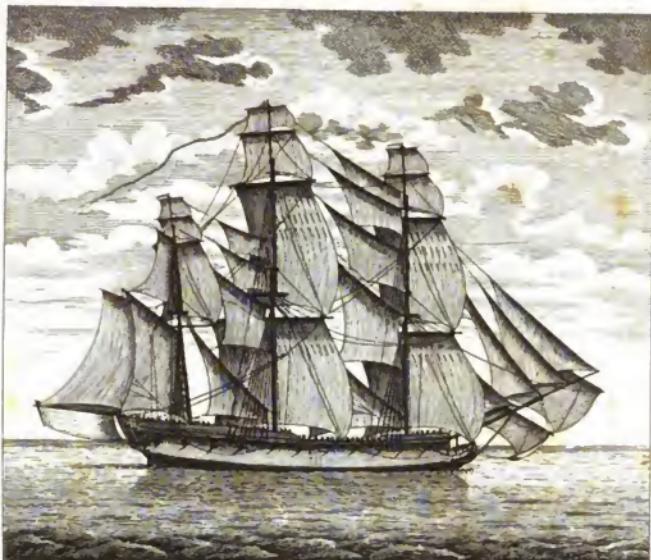
*A treatise founded upon
philosophical and rational ...*

William Hutchinson

B.S. 4th
105







Britannia's Glory, first fromr SHIPS alone -
In SHIPPING still her power & wealth she Cares
Let each Experience'd BRAVE then Impart -
Her Naval skill to Perfect naval Art -

Ballou. A.

A

T R E A T I S E

FOUNDED UPON

Philosophical and Rational PRINCIPLES,

TOWARDS ESTABLISHING FIXED RULES,

For the best FORM and

Proportional Dimensions in Length, Breadth and Depth of

*Merchant's Ships in General; and also the MANAGEMENT

of them to the greatest advantage,

B Y

Practical Seamanship;

WITH

IMPORTANT HINTS AND REMARKS

RELATING THERE TO;

FROM

LONG APPROVED EXPERIENCE.

BY WILLIAM HUTCHINSON, MARINER,
And DOCK MASTER at LIVERPOOL.

LIVERPOOL:
PRINTED BY THOMAS BILLINGE, CASTLE-STREET.
M,DCC,LXXXI.



THIS BOOK
IS MOST HUMBLY DEDICATED,
TO HIS ROYAL HIGHNESS
WILLIAM HENRY,
DUKE OF CLARENCE,
PRESIDENT
OF THAT MOST PATRIOTIC SOCIETY,
INSTITUTED AT LONDON,
FOR THE IMPROVEMENT OF
NAVAL ARCHITECTURE,
BY HIS ROYAL HIGHNESS's
MOST HUMBLE SERVANT,
William Hutchinson.

T H E

A D D R E S S.

THIS Treatise on the best form for constructing merchant's ships, and the management of them to the greatest advantage, by Practical Seamanship; with important hints and remarks relating thereto, is most humbly addressed to all whom the different parts concern, but more particularly to Owners and Builders of ships, young sea Officers and Pilots, who consider and consult what ought and can be done for safety and success which crowns all, and may be called the foundation on which all our commercial interest by sea depends.

Although it must be allowed, that drafters and builders of ships, should be the best judges, how to make them answer the different trades they may be designed for; yet as a seaman, I hope to be excused pointing out what has appeared to me great defects in practice, not only in the great diversity of their forms, but in their proportional dimensions, some built too short, or too long, too high or too low, too narrow or too broad, too sharp or too full in general, or in different parts, that must make great diversities of properties, which cannot be known but by comparisons of fair trials in practice, under the same circumstances. And there certainly must be a medium here to avoid the bad properties occasioned by these extremes, which is all that I pretend

pretend to, endeavouring to describe what I have learned from experience, observation, study, and conversation on these important subjects. And no doubt, but if learned men of Science were encouraged to make them their study, but great improvements would be made in them.

A late great Mathematician at Liverpool, Mr. Richard Holden, who found Theory from the Attractive powers of Nature, to agree with my observations on the tides, and made a most excellent Tide Table from them, as particularly noticed in this book; used often to say at what we called a Skip Club, that there was no hidden or unknown principles, concerned in the art of building, sailing, working, and managing of ships, but the laws of motion, the pressure of fluids, and the properties of the lever, which are all well known to British Philosophers, and that nothing was more deserving their attention and pursuit, in order to bring these arts to their utmost perfection.

And our great Sir Isaac Newton long ago pointed out the Solid of least resistance, which shews what might be done if our Philosophers, Mathematicians, and Mechanicians, in conjunction with professional men, would apply their talents from observations and experiments, endeavouring to get general rules from principles, fixed upon greater certainty.

Our famous Philosophical poet, Mr. Pope says, by indirections we find directions out, which has been the rule of my pursuit, and if it was followed by professional men of science, no doubt but all the subjects of this book might be brought in time to a regular system.

But it is in building ships as in the management of them by Practical Seamanship, that men in general are so devoted to the modes they have been accustomed to, that they cannot be prevailed upon to try any other, whilst others try impractical methods, and attempt to make ships do impossibilities such as to back them a stern, clear of a single anchor, when the wind is right against the windward tide, that drives them

to windward of their anchors; or to back a ship with sails so fit as to prevent her from shooting a head towards a danger when laid to, or driving broadside with the wind right against the tide, not knowing that a ship driving on either tack will always shoot and advance bodily forward the way her head lies, in spite of any sails that can be set aback; all which, I trust, will be shewn in their proper places in the following work.

Not only the above instances, (by which I have known ships to go on shore,) but the whole duty and conduct of sea officers, as far as mentioned in this book, has hitherto been left entirely to the slow progress of experience, by which means they, and all concerned with them, are constantly liable to be great sufferers from mistaken practices in seamanship.

Frequent observations of this defect, induce me to endeavour to fix the best rules for Practical Seamanship, that seamen may not be left entirely to learn their duty by their own and other people's misfortunes, which has been the case hitherto, but by the experience of others who have gone before them. From all that I have seen, in the many different trades that I have been employed in, the seamen in the coal and coasting trade, to the city of London, are the most perfect in working and managing their ships in narrow, intricate, and difficult channels, and in tide ways; and those in the East India trade are so on the open seas.

These reasons, and that the most of the useful arts have been made publick, to our great improvement and advantage, emboldens me to publish on this long neglected subject, the following sheets, which are the result of much labour and application; but which I must own, will appear to great disadvantage from the unexpected difficulties I have found, in being a new writer, venturing to lead the way on so important and extensive a subject, in this learned criticising age; but for my imperfections, as a scholar, I hope the Critics will make allowance for my having been early in life at sea as cook of a small collier;

collier; and having since then gone through all the most active enterprizing employments I could meet with as a seaman, who has done his best, and who, as an author, would be glad of any remarks candidly pointed out how to improve his defects, if there should be a demand for another Edition.

The following Note from the PRESIDENT of the Maritime School on the Banks of the Thames, which I received along with a Book of the Rules and Regulations of that INSTITUTION, I have inserted, more with a view of enforcing the Use and Advantages of a Work of this Kind, than from a Motive of Vanity; being ready to acknowledge the Compliment too flattering.

"Sir Thomas Frankland presents his Compliments to Mr. Hutchinson, and hopes he will approve their INSTITUTION. "He makes their Superintendant read over, with the eldest of the Boys, his Treatise on Seamanship; which he thinks seems as if written for the Instruction of their Maritime School at Chelsea."

" NOVEMBER 30, 1781.

"N. B. He wishes the officers of the Navy would study it also." "As my best Endeavours have hitherto been exerted for the Public Good, without any other Motive; so will they be continued, by

The Public's Humble Servant,

WILLIAM HUTCHINSON.

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E R R A T A.

PAGE 28, *l. 1*, for page 21, *read* page 22.
Page 36, *l. 9*, from the bottom, for wood, *read* wood.
Page 38, *l. 9*, from the top, for swell, *read* smell.
Page 50, *l. 17*, from the top, the word in, dele.
Page 51, *l. 14*, from the top, for shave, *read* sheave.
Page 52, *l. 4*, from the top, for shore, *read* shore.
Page 56, bottom *l.* for the more equally, *read* more equal.
Page 61, *l. 2*, from top, from the best, *read* for the best.
Page 84, *l. 10*, from the top, *read* as the wind and weather.
Page 85, *l. 10*, from the top, *read* to make.
Page 87, *l. 9*, from the bottom, for would, *read* should.
Page 100, bottom *l.* for larboard, *read* starboard.

These two lines omitted, page 128, from the top, after 20th line.

“ By precept he has us enjoin’d,
“ To keep his wonderous works in mind,
“ And to &c.

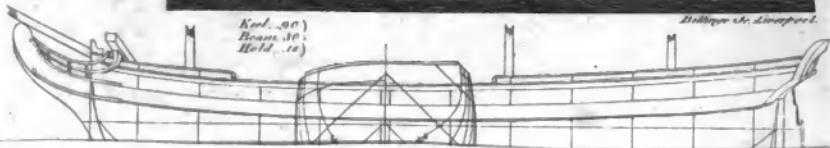
Page 163, *l. 4*, from top, for stay-sails, *read* main-stay-sails, *l. 8*, *read* warded.
Page 210, *l. 10*, from the bottom, for part, *read* port.
Page 217, *l. 10*, from top, for bright, *read* bight.
Page 285, *l. 3*, from the bottom, for his, *read* is.

REFERENCE to the PLATES.

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PLATE C



C.
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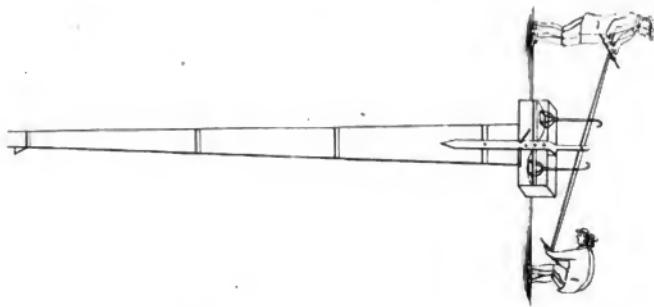
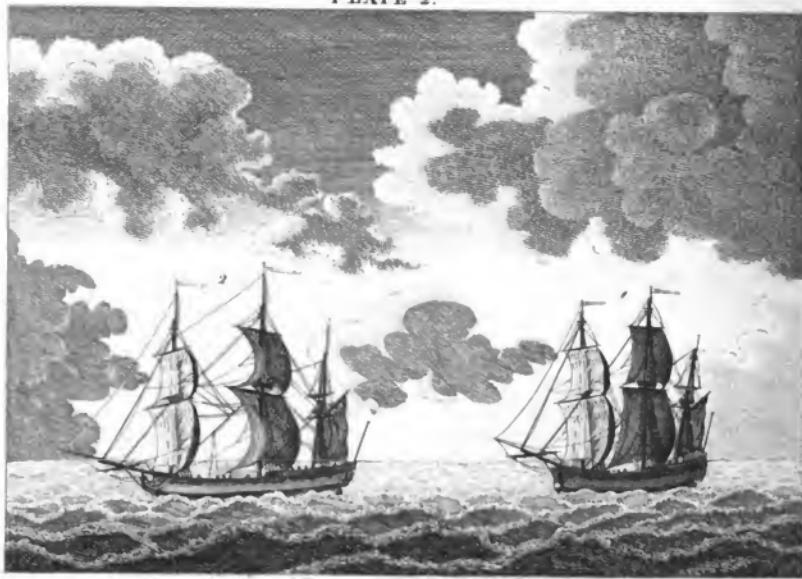


PLATE 3.

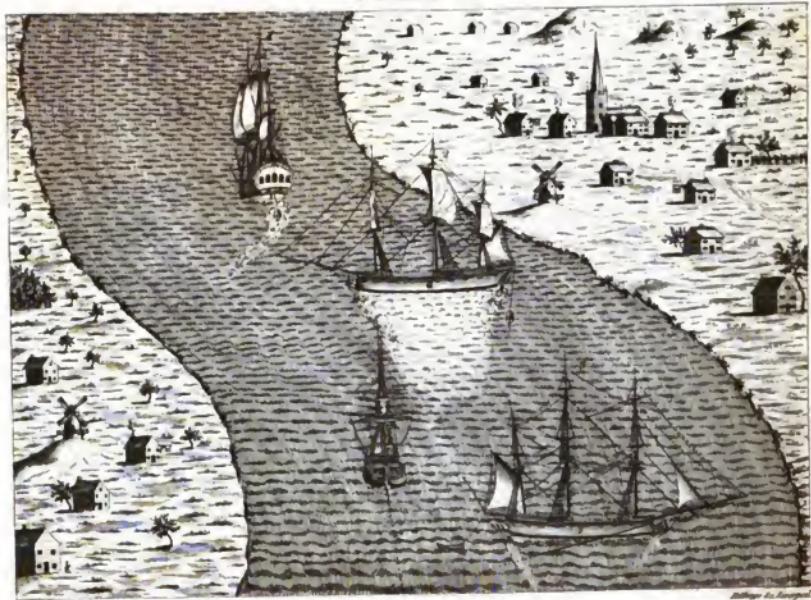


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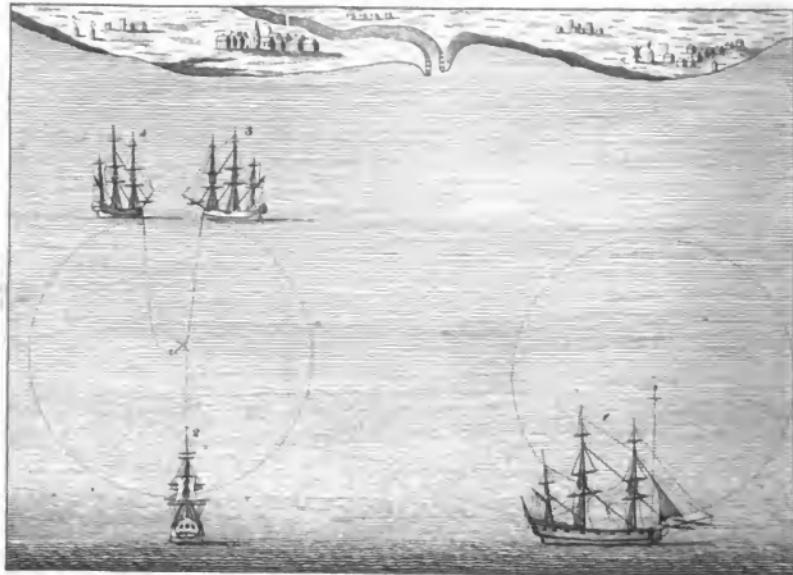


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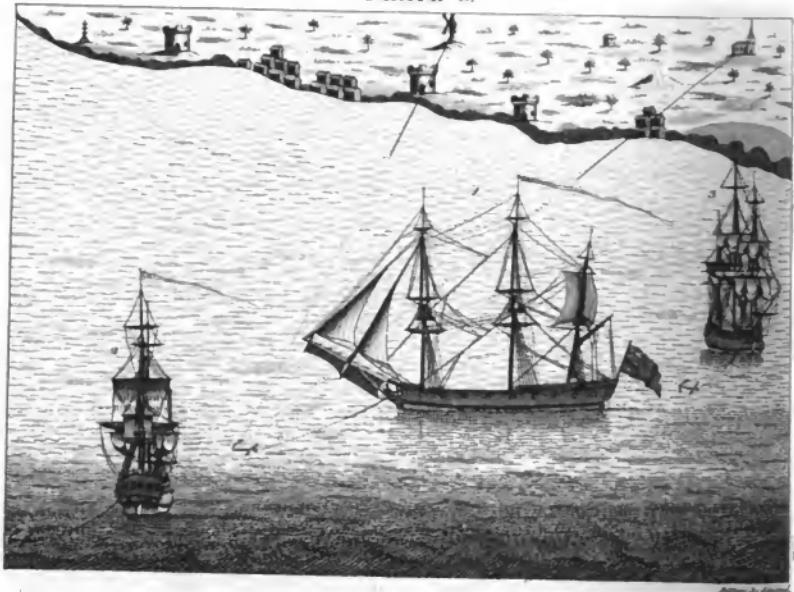


Fig. 1

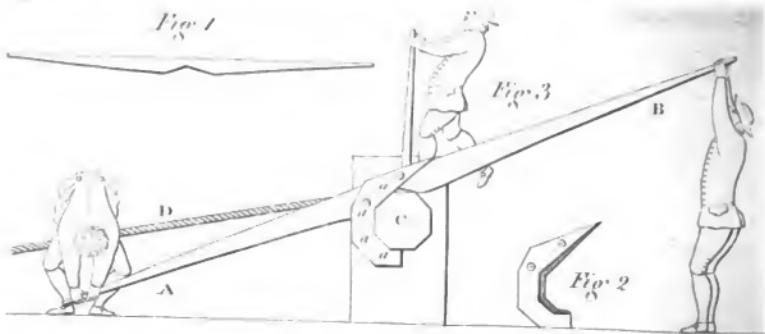


Fig. 3

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Fig. 2



PLATE th 6.



Boatman Jr. engraved.

PLATE 7.

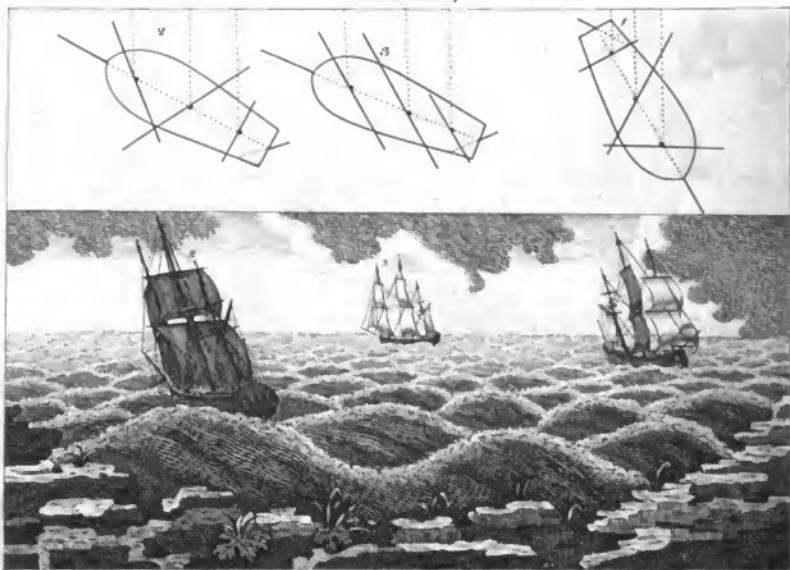


PLATE 8.

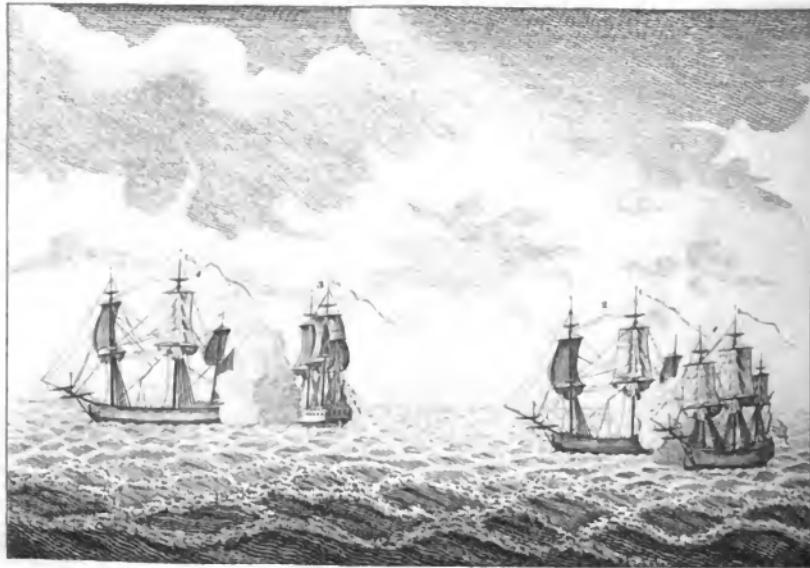
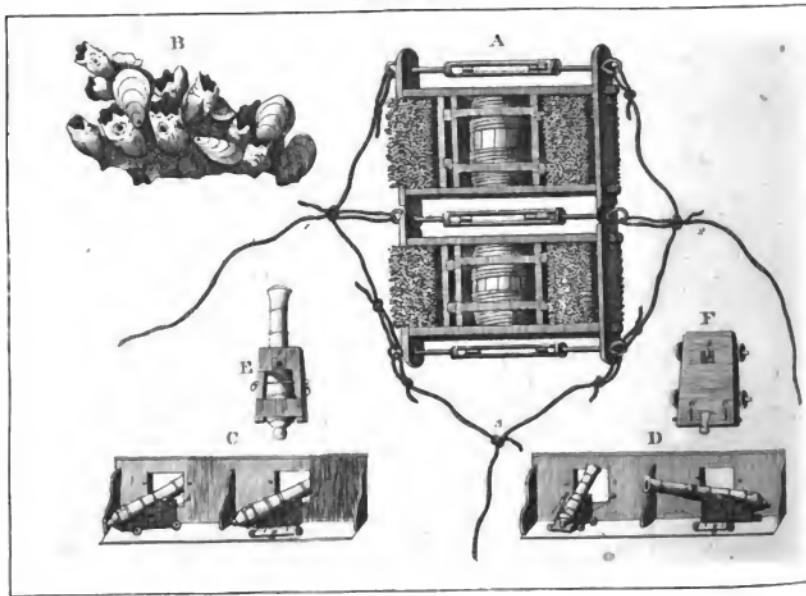
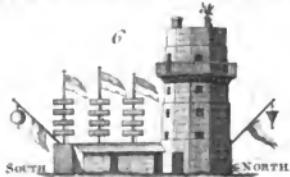


PLATE ⁶ 9.



BIDSTON LIGHT HOUSE and SIGNALS

6



SOUTH NORTH

Vessels coming in

For Vessels coming in
 Ship all day on the South Flag Staff
 Brigs 11° on the Middle D.
 Snow Ketch Hys } 11° on the North D.
 or large Schooners } No more than five Vessels of one kind acting on 1 Proper Staff

SIGNALS of DISTRESS

For Vessels in Distress or in Case of Rock Channel or such like coming in

On the Oblique Pole to the Southward of the Light House
 Ship a Ball with a Flag half Mast
 Snow a low broad end optical glass half Mast
 Brigs or small Vessels D. small end up a Flag D.

Going out

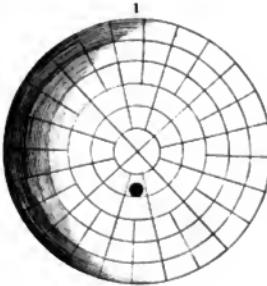
The same as above but a broad Pendant instead of a Flag
 IN FORMBY CHANNEL

coming in

On the Oblique Pole to the Northward of the Light House
 Ship a Ball with a Flag half Mast
 Snow a low broad end optical glass half Mast
 Brigs or small Vessels D. small end up a Flag D.

Going out

The same as above but a broad Pendant instead of a Flag



3

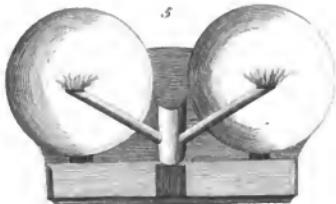


FIG. 5

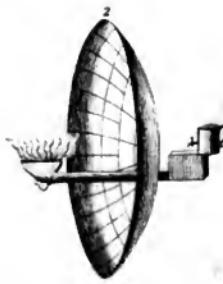
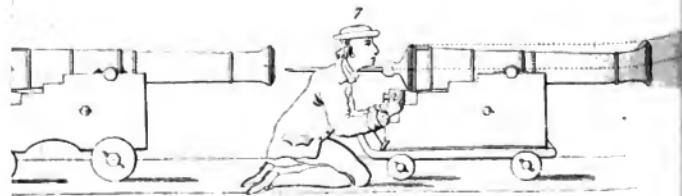
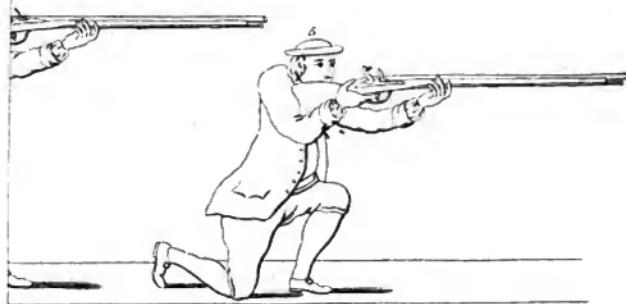
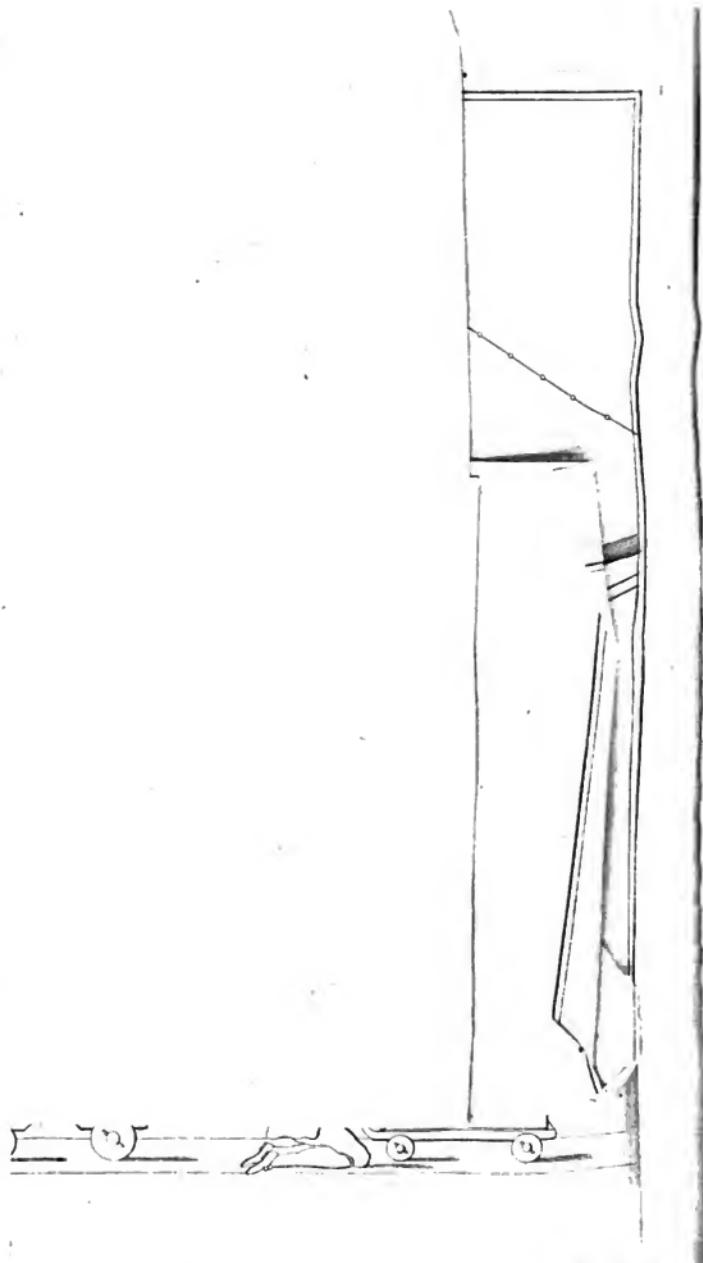


PLATE II.





PRACTICAL SEAMANSHIP.

AS the management of ships depends upon the air, or wind, and water, I hope I shall be excused in taking the liberty to endeavour to explain what I know from experience, or have learned from others, of the properties of these fluids, so far as they may concern ships and practical seamanship.

On A I R.

IT is enough for our purpose here to say, that air in motion, which is one of the principal causes of the motion of ships, is a fluid body, as much as the water they swim in. This is proved from many experiments, and may be perceived from what we see ordained by the *All Great Author* of nature, in birds, insects, and all animals that fly, how they float or swim, steer, and govern their directions through the air by their wings and tails, upon the same principles that fishes swim in water.

AIR is proved by experiment to have its weight *in air* of about seventeen grains to a quart, near the surface of the sea, as a quart vessel from which the air is drawn by an air pump, weighs about seventeen grains less than when the air is in it; but the air weighs less and less in proportion as it is higher above the surface or level of the sea: And its property is to buoy up, or raise, any matter which, bulk for bulk, is lighter than itself; as may be seen by smoke, steam, or vapours, rising up to certain heights, 'till they come to air that is of the same weight with themselves, where they float, and make mists, fogs, or clouds, which darken the sky, and hinder us from seeing any considerable distance about us, 'till they are dispersed or separated, or fall in rain, snow, &c. Of this property, a most striking instance has been of late produced, in the invention of the Air-balloons, which have been so curiously constructed as to carry men to vast heights and distances through the air, even over the sea from England to France.

A

CONFINED

On foul
air in ships

CONFINED air in ships deserves particular notice ; it often occasions diseases, and sometimes immediate death, as has frequently been the case in the pump wells of ships of war. Charcoal fires, &c. in close places, are dangerous and sometimes fatal. Too many people together in close places, and filth and dirt made and suffered to continue below, foul the air ; therefore every seaman who does not know it should be told, that by his common breathing he fouls a gallon of air, and requires a gallon of fresh air to breath in, every minute ; so that for the preservation of themselves, they should not grudge or think much to keep the places where they rest and sleep, as clear and clean as things will admit of ; and should use every method possible to keep ships clear of bad, tainted, air, which becomes proportionably heavier as it becomes more foul, and, losing its circulating property, naturally descends to, and stagnates in, the lowest vacancies, where it hinders to corruption every thing that is subject to decay, even the ship and her materials ; and much more so the provisions, which must consequently make unhealthy ships.

To get
clear of
foul air.

Foul air in ships frequently proceeds from their being over crowded with people below, which may prove very fatal. To prevent the bad effects of its lying in a ship, I would recommend to keep the pumps constantly working (tho' no water in the ship) 'till a lighted candle will burn clear in the bottom of the pump-well, where the worst air lodges, as being the lowest and greatest vacancy in ships holds ; since all water pumps, will act the part of air pumps, or ventilators, as it is known that the water would not rise to the sucking pumps, if the air was not first pumped out of them. And as Guinea ships, whilst the slaves are on board, have their large close fire furnace standing nearly over their pump well, how easy might a short copper pipe, of about four-inch bore, be made to go into an iron nozzle in the side of the furnace, and the other end into a lead or wooden pipe of near the same bore, that might be carried down into the pump well, by various ways ; and as they make their fires for cooking just after midnight, which is the time when all the slaves are below, and then ventilators are most wanted, it is known from experience in ships of war, where such like pipes are used, that whilst the fire burns, by its rarefying power, it will draw up and expel a constant stream of air from the pump well ; so that by these means, the lowest and foulest air may be got out of ships, and the fresh air will naturally circulate and take its place.

THE

THE power of the air's pressure on all bodies near the surface of the sea, is computed to be about fifteen pounds weight on every square inch. It presses every way in all directions, not only downwards, but slanting sideways, and upwards, as may be seen in common, without machines for that purpose, by those little round leather suckers (as they are called) used by boys at play, which when wet, and clapped upon smooth stones, press the air from between the stone and the sucker ; hauling upon the string, in the middle it makes a small vacuum, or little hollow space void of air, and the air's pressure upwards opposite to the vacuum, is the power by which the stones are supported when carried by boys about the streets.

THE pressure of the air downwards is known and experienced in many cases, and its bad effects are felt upon ships sometimes when they take out a raft-port, which they think high enough out of the water when the ship is afloat ; but if she after that grounds, by the tide leaving her upon mud, so as to press the water from under part of the bottom, the air's pressure downwards against that part in the mud, where there is neither air nor water, will confine the ship from rising out of the mud, 'till the water flows much above her floating mark, and the water may run in at the raft-port and sink her. And when small vessels are deep loaded, and lie a-ground upon mud, and especially if their bottoms are flat---such as a great number of vessels are which carry goods up and down rivers---the masters dread and avoid, as much as they can, laying them in the mud, on account of its suction, as it is commonly called, and thought to be, but it is entirely owing to the air's pressure downwards, acting upon the parts where the air and water are pressed from under them, that their vessels are in danger of sinking, being unable to rise or float out of the mud, and pieces of sheathing are sometimes pulled off ships bottoms, from the same cause, when the water gets between the bottom and the sheathing, and none between that and the mud. The same cause will also keep wood, or any other thing that will swim, and is lighter than water, from rising ; for if their buoyancy don't lift them before the water flows upon them, the weight and pressure of the water is then added to the air's pressure downwards to prevent their rising.

If a man, tho' famous for swimming or diving, by accident should fall, or, out of bravado, jump into the water to dive, if his feet only reach the mud, and sink so far as to press the water from ^{How mud} _{his feet to be drowned.}

How the
air's pres-
sure may
cause to
sink ships,
&c. which
ground in
mud.

under them, the pressure of the air and water downwards, will hold his feet so fast, that all his struggling won't be able to relieve him : The only help that can be given him, is by something that he may grasp or lay hold of with his hands before he loses his senses, or by a boat-hook, &c. to hook him at all hazard, and to haul him out of the mud.

The air's pressure is the cause of what is commonly called suction.

WHAT is commonly or vulgarly termed suction, is caused by the pressure of the air, which forces and raises the water upwards, in our common sucking pumps, as they are called, where the working of the boxes and clappers only pumps up the air first, and takes off its pressure downwards from the inside or bore of the pump ; then the air pressing upon the water in the well, will make it rise to the height of thirty-three feet above its level, up a pump or pipe, where the power of the air is so taken off ; and quick-silver, which is about fourteen times the weight of water, will rise to about thirty-one inches in a tube or glass pipe, void of air :-- And these prove a balance, or equal weight to the pressure of our air or atmosphere ; which air when in its most dense or heaviest state, will very seldom raise these fluids higher.

On judging of the weather from the weight of air.

BUT the air in our Northern climates is constantly varying, and is sometimes about a tenth part rarer or lighter than at other times, consequently, when lightest, loses about a tenth part of its power to buoy up any matter that is floating in it, or to raise water or quick-silver, which last then stands at its lowest station in our barometers or weather-glasses, at about twenty-eight inches high, on the index where the weather is marked. When the air is in its rarest or lightest state, either the watry particles floating in it will fall in snow or rain ; or it is made light, by an over charge of elementary fire or sulphureous particles floating in it, by which I had my sails stuck full of black specks, from the dews falling then upon them, when sailing upon the coast of *Barbary*. This inflammatory matter in the air, probably, is the cause of lightening and thunder ; for I have seen the same sort of black specks on the sails of ships, where they have been struck and torn with lightening ; and if rain, snow or thunder, does not happen, a storm of wind (as mark'd on the index) is expected to be the consequence, by the air's flying or rushing along with a swift motion, from where it is dense, or heavier, and endeavouring to come to an equality in weight, with the place where it is rare or in its lightest state. As the air increases in its weight, it presses the heavier on the quick-silver below, and raises it proportionably higher in the tube ; and when it comes to twenty-nine inches and a half, the air

air is then reckoned at the medium or middle state, and there the weather is marked changeable ; but when the quicksilver comes to be forced above thirty inches, from that to thirty-one inches, is marked fair, dry, frost, serene weather, &c. as such may be expected, when the air is dense, or in its heavy state, it then raises and buoys up the particles floating in it, to a greater height, where they may be separated so as to make the sky clear of clouds for a time. These are the conclusions which I imagine our philosophers fixed on, when they endeavoured to construct the barometer, or air weigher, to foretel the different weather that might be expected.

BUT, (as a sailor) I venture to say, that the weather often proves very different from what it is pointed out by our weather-glasses, or by any other of those improved instruments or rules that have been made by later and more accurate observers of the air and weather that I have yet seen, and I doubt their being of any great service to sea-faring people ; for I have seen strong gales with a high weather-glass ; not only Easterly, (which commonly raises the quick-silver,) but when up at thirty inches, I have known it blow strong Westerly, with rain and snow ; I have likewise seen moderate and fair weather, with the quick-silver as low as twenty-eight inches three tenths. I have been in the open ocean, a long way from any land, in moderate and fair weather, sailing pleasantly along, when suddenly the ship has been struck with a single flash of lightning : This inflammable matter in the air, like electrical matter, *seemed* to take fire at the touch of the ship's masts.

BUT in justice to barometers, I must own I had once, and but once, the advantage of a true admonition of an approaching storm of wind, from Tampion's portable barometer, which I carried to sea with me as a weather-glass for some time ; and this happened at the mouth of the English channel, when about seventy vessels sailed from the Downs, with a moderate breeze in the S. E. quarter. In the morning after leaving the Downs, I perceived a sudden fall of the quick-silver, from about twenty-nine inches and a half, to about twenty-eight inches and a half ; we had then all our small sails set ; on this alteration, I ordered all hands to work, and took in our small sails ; got down top-gallant yards, and did all that was thought most necessary, to prepare for an approaching storm, which came on about eight in the evening, when

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A storm
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when we were a-breast of the Lizard: the wind from being moderate at S. S. E. came suddenly to N. N. W. and blew so strong, that though we had no sails loose but the fore-sail in the brails, yet it laid the ship more down on her broadside than ever I knew her, by any stress or pressure of sails. This sudden change of weather, and of the wind to the opposite point of the compass, probably proved of bad consequence to all who were unprepared for it. The next morning we saw a Dutch or Danish ship, floating bottom up, which we supposed was loaded with timber, and had been overthrown by this unexpected storm, taking her a back with all sails set; and the accounts we had afterwards, were, that most of the fleet suffered damage.

On the defects of a weather-glass for sea service

BUT I must acknowledge a defect in this portable barometer, for sea service, which is, that the quick-silver always kept the ships motion up and down, so that its height must be taken from the medium of that motion; and I never had the opportunity of meeting with the marine barometer, such as was carried to sea by the great Doctor Halley, and which I judge, from its not being continued in practice, has not answered the commendable design, of giving some certainty of the weather, which ships at sea may expect; which opinion I think further confirmed by the observations and remarks made by that greatest of all Navigators, Captain Cook, *with those improved marine barometers, which he had with him in the voyages he undertook, with a view to explore the world. Yet it must be allowed, that the discovery of these properties in the air or atmosphere, has proved of great advantage in the management of pumps and syphons (or crooked pipes to raise water) and in many other useful inventions.

* The character of Captain Cook is sufficiently exemplified by the services he performed, which are universally known, and which have ranked his name above that of any navigator of ancient or modern times. His useful life was one continued scene of activity in an eminent degree. He first sailed in the coal trade from Whitby, leaving several years an apprentice, and continuing afterwards as mate in it. Tho' offered to be made master of a vessel in that employ, he preferred entering (when the war broke out in 1755) on board the Eagle, a 64 gun ship, of which Sir Hugh Palliser soon after took the command; which proved the foundation of the future fame and fortune of our great circumnavigator, who was promoted to the quarter-deck, and ever after patronized by him, with such zeal and attention as reflect high honour on his character. To Sir Hugh Palliser is the world indebted for having first noticed, in an obscure situation, and afterwards brought forward in life, the greatest nautical genius that ever any age or country has produced.—His life, by a melancholy event which all Europe deplored, was unfortunately cut short; but if we should estimate it, by the usefulness of it, by the many active and enterprising scenes in which he was engaged, by the important discoveries which he effected, by the greatness of his worth, and the tunefulness of his fame, he might be considered as having lived very long indeed.

WIND may be said to be only the air moving over the surface of our globe, from one place where it is heavier, towards another place where it is lighter, which difference occasions its different directions; and the swiftness of its motion, is in proportion to the different densities of the air in different places, as PROVIDENCE has pleased to order it for many valuable purposes.

We call it calm, when the air is without motion; but when the air moves, we call it wind; and its power is calculated to increase, in proportion to the square of its velocity or the swiftness with which it flies, which is at the rate of about sixty miles an hour, in one of the greatest storms in our climate, as the ingenious Mr. Smeaton has shewn in his table of winds, after he had found out what may be called the fixed standard for wind-mill sails, from curious experiments, which I have seen him make in a close room; for the air though at rest, or in a calm, will act upon any body that is put in motion, as so much wind of the same swiftness. Suppose a ship launching in a calm to gain a velocity, or run at the rate, of a mile in a minute; at this time, this calm will produce as great an effect on the ship, as one of our greatest storms of a mile in a minute, or sixty miles an hour, would have had upon her stern, when she was fast upon the stocks; and a ship launched with the same velocity, and in the same direction with this storm of wind, would feel it calm, for the time she run as fast as the wind blew, as may be noticed, when it happens that ships are launched with a brisk wind, and their colours blowing aft, the same way they are to run, when they come to a quick motion in launching, their colours fly forward for that time. And when any body is put into so quick motion through the air, as not to give the air time to close behind it, in that case it makes, in some degree, a vacuum, and in proportion to this vacuum, there will not only be the resistance, but the pressure of the air, acting upon these bodies, which may be near fifteen pounds upon every square inch; and this may be the reason why ships' masts and yards, sometimes are rolled away in a calm, when they are put into so very quick motion, by a laboursome ship's rolling. A ship under way in a calm, where there is a strong tide or current, will be affected as if a light air or gentle wind was right against her, and in proportion to the strength of the tide or current, a ship will feel less or more wind in proportion to the rate of the tide or current.

WIND.

On eddy winds, and how the wind is altered from its natural direction. WIND in many instances is altered from its natural direction, as in a narrow river, that has high land, or high trees, close to the water, on each side; there the wind commonly blows either right up or right down the river. When the wind blows right across a river, or right off any high land, or when ships are close under high land, when it blows strong, they often feel such gusts of eddy winds in all directions, that their pendants are sometimes seen to be blown right up in the air; in such situations, they can't trim their square-sails fast enough to any advantage, therefore it is best to have the square-sails close furl'd; and if any sails can be of advantage, it must be the stay-sails, mizen, boom sails, try-sails, and such others, as may be worked without laying so long aback, as to give the ship stern-way.

A ship failing close by the wind, one particle, or part of air, drives off the other from the lee or after-leech of the sail, which turns the wind from its direction for a little time, as may be noticed, by a ship's after-sails being obliged to be trimmed sharper than her head-sails, and her ensign not flying above three points to leward, when the ship is failing near six points from the wind.

WHEN ships are failing quartering, or before the wind, the wind then blows perpendicular to, or right upon the sails, which makes them bag more, or form a hollow, so that the wind when it blows strong, may compress the air in the belly of the sail, into less compass than its natural state, for air, contrary to all other fluids, has that property, that it may be compressed into a very small space, as is known by charging and discharging of wind-guns, &c.

On W A T E R.

The properties of water. WATER is a fluid element about 800 times heavier than air, capable of floating ships;—and philosophers tell us, that the particles or single parts of water are so small, that their form cannot be perceived by the best microscopes, or greatest magnifying glasses; but that they must be round and smooth, from their moving so freely one against another; and from their easily giving way, and opening a passage for all bodies moving therein: And particles of water must be hard, and touch each other, as it is known from experience, that water cannot be compressed, or forced into less compass than its natural bulk, except in a small degree, by any power or weight that can be employed upon it; and as acting and re-action are equal, and contrary

contrary to each other, it re-acts as it is acted upon, and its power of pressure is so regular that the standard value of gold is regulated by it, and progressively increasing its power according to its depth.

WATER will float the greatest or heaviest bodies that take up more room in water than itself, and ships, boats, or vessels, with all they contain in or about them, and all other things that will float in water, are exactly the same weight as the bulk of water displaced, by the bulk of that part of their bodies actually in the water, and below their swimming mark, which is lower down, or higher up, according to the weight, or density, of the water they swim in; for ships are known to swim lighter in salt water than in fresh, in proportion as the salt water is heavier than fresh: Therefore, suppose a pint of water to weigh a pound, (as it does, or thereabouts, in common,) any thing that will swim in water and weigh a pound, put into a vessel full of water, will displace or make run over, its own bulk of water to its swimming mark, a pint for a pound. The same rule holds good with respect to ships of the greatest burden, or to other bodies according to their bulk.

THE power and pressure of water is known to increase according to its altitude, regardless of its quantity; for suppose a tight dock to be made, that would nearly fit to the shape of the bottom of one of our first rate ships of war to her floating mark—half an inch, or the least thickness, of water would lift and float this ship, as effectually as the whole ocean; for water, like other fluids, presses equally in all directions; therefore, the water must press equally against the ship, as it does against the dock, which must consequently float the ship as soon as the water comes to the height of her floating mark: And suppose this dock could be filled with water when the ship is out of it, that water would weigh the same as did the ship when with all her materials then in and about her, and the very small quantity of water which floated her, added to that.

IF a ship has the flattest part of her bottom lying sixteen feet deep, (which is often the case,) the water then presses sixteen times, as much upwards against this flat part, as it does on any part of the same ship about the water's edge, and so on to any other part according to its depth. And suppose this ship to have four leaks, or plug holes, of equal bigness, that could be drove out occasionally, the first at one foot under water, the second at four feet, the third at nine feet, and the lowest at sixteen feet in the flat part of her bilge; that hole at four feet deep would leak or let in as much water again

On the
pressure
of water
and leaks
at different
depths.

in the same time, as that at one foot deep; and that at nine feet, three times as much; and that at sixteen feet, four times as much though it run into the ship upwards; and so on in proportion to the square root of the height of the water above the leak or plug-hole; therefore leaks in ships are more or less dangerous, according to their depth under water.

Different shaped bottles broke by the water's pressure.

THE great Doctor Halley says, that the pressure of the water at thirty-three feet deep, which is equal to the pressure of our atmosphere,) pressed the natural air into half its space in his diving-bell. I have tried experiments on the pressure of water upon bottles of different shapes, corked up without any thing in them but common air, making them fast to a lead-line just above the lead; when two common square flat-sided cafe-bottles, which would hold about three half pints each, broke at the depth of between six and seven fathom; but two oval formed thin florence flasks, of nearly the same size, bore the pressure to about fifteen fathom deep; and a quart bottle round one way, but having two sides somewhat flattened, bore about fifteen fathom; and a round common quart bottle, broke only at about twenty-eight fathom. At great depths I imagine few things that are made hollow and tight will bear the water's pressure; I have seen an instance of its great power, when, my ship driving off the bank in Gibraltar-Bay into deep water, our anchors would not reach the ground at a hundred fathom; and when we hove them up, we found our two new nun-buoys had their sides crushed inwards by the water's pressure.

On waves.

WATER at the surface is powerfully acted upon by the wind, and by that according to its strength, which forces the water from its natural level, which it always endeavours to come to, but is prevented and disturbed by several causes acting upon it. When the water is in motion by a strong tide or current, and the wind blows strong against it, it makes the most dangerous and troublesome waves. High waves at sea are supposed to move along at the rate of about twenty miles in an hour.

Observations

THIS may be called the foundation on which all navigation interest may be said to depend. Therefore particular notice should be taken of all vessels floating in water, from the greatest sailing ships, to the smallest rowing and towing boats in shoal water, and canals that are now become numerous, and of great advantage to trade in general, both in Britain and Ireland. And canal waters being so shoal that its particles have not room to recede downwards when pressed upon by the too full bows of the vessels going upon them, they should be built sharp forward like the London wherries that carry passengers on the River Thames, when obliged to row in shoal water against the tide; they separate and divide the particles of water at its surface where it has room to recede to each side, are not built with flanging full bows that drive a swell of water before them that obstructs their head way. Ships built with too full bows are obstructed by the same natural cause, and lose their steerage in proportion as they shoalden their water, by smelling the ground as it is called by seamen.

About the year 1755, I went to Chatham, where I observed the Royal Sovereign first rate ship of war, in the repairing dock, laid upon blocks that formed a convex curve, about two feet higher under her main frame, than at each end of her keel, in order to suit her hogged concave bottom, which I reckon was occasioned by her being built with a long straight floor, which certainly must be allowed to make the most unnatural, unfair and worst bottoms for ships to sail, steer, stay, or wear well upon; or even for freight ships to stow cargoes upon, which great defect by all possible means ought to be guarded against and improved, by building ships with convex bottoms curved downward in their length, as described page

Observations on Ships built with long straight Floors.

THESE floors have been always reckoned to give ships every good property, and are formed by having a certain number of floor timbers, exactly of the same mould fastened equally high upon the straight keel in the main body of the ship, which are called so many dead flats, from whence the other floorings begin to rise sharper by degrees, till they stand upon dead wood towards the stem and sternpost, to form the entrance and run of the ship.

Reasons why such a Ship's bottom hogs so soon.

The bottoms of such ships bend easily both ways.

REASON, as well as long ago experience, should have taught us, that this is far from being the best method to construct ships' bottoms; for, from the time of their being launched, these bottoms are very liable to be bent easily both ways, either hogging upwards, or fagging downwards, to dangerous degrees, in proportion as the upward or downward pressure happens to prevail, without appearing to alter the sheer of her upper works for a time, till age or accident soon fixes the bottoms with a constant hog or curve upwards, which not only weakens them greatly, where their upper works are lowest and weakest, but lessens their holds in the main body of the ship, so that they stow and carry less weight there in proportion as their long floors are hogged upwards. This makes one of the most unnatural, worst formed bottoms possible, which makes them very defective, as above mentioned; or even to take the ground without damage, as will be proved from facts.

Reasons why such a Ship's bottom hogs so soon.

Much less pressure will bend or break any thing flat, than if rounding outwards.

IT has been long known by experience, and proved experimentally, what little stress, strain, or pressure, will bend or break any straight or flat things, or vessels, in comparison to those that are made curved, to form a convex arch, rounding outwards, against the pressure and strain that is to act upon them; as may be observed in those almost flat arches of bridges and vaults, that are built with such small loose brittle materials, as bricks, lime, &c. what great weight and stress they will bear upon them without damage.

Further proved by experiments with the air-pump.

IT is well known how little air can be pumped out of any vessel that is made quite straight or flat sided, before it is bent or broke by the outward pressure of the air upon it, in comparison with those vessels made convex, or rounding outwards, which, made of very slender materials, such as glass, &c. will bear the whole pressure of our air or atmosphere, (which is reckoned to act with a power of fifteen pounds weight on every square inch of surface,) without being hurt. But the first natural cause that acts upon these ships' bottoms to hog them is the pressure of water, the nature of which therefore deserves particular notice and attention on this occasion.

I HAVE

I HAVE already observed, in the chapter on water, its weight, which is 800 times greater than that of common air, bulk for bulk; and the great power with which it presses *in all directions* according to its depth; insomuch that the air in Dr. Halley's diving bell, at thirty three feet deep, was compressed by it into half its natural space. And I have related some experiments I made, on the power of the pressure of water at different depths in breaking glass bottles, by which it appeared that those of an oval, or circular make, though thinner, bore a greater pressure of the water before they burst.---These experiments serve to shew, and experience will confirm, how liable these long straight floored ships are to hog, for the time of their being launched with empty holds. Let us suppose the middle flat of their floors to be eight feet under water, which presses upwards against it eight times as much as it does on the parts at the water's edge, when at the same time the thin sharp parts of the entrance and run of the ship, occupy so small a space in the water, that its pressure upwards acts very little to support the high, heavy, projecting parts of the head and stern in proportion to what it does amidships, where ships are built lowest and weakest, which must tend greatly to hog them, till a proportionable weight of ballast, materials, or goods is stowed there to counter-balance exactly the pressure of the water upwards upon their floors. Or when improperly stowed, or loaded with too much weight close fore and aft, where there is very little bearing body under water to support it, and too little weight in proportion amidships, when the flat of the floor may be fifteen feet under water, the water will then press upwards against it fifteen times as much as it does on the parts at the water's edge, which will act with a power to hog them, in proportion as weight is wanting there to ballance that pressure.

On these Ships being hogged by taking the Ground.

IN conversation with the advocates for this form of building ships, amongst the many arguments they endeavour to give in their favour, they make use of that of their taking the ground to great advantage by their lying upon so many level floor timbers to support them. Yet from observation I can say that whoever takes notice of them when they come a-dry, even upon hard level ground,

or

On these Ships being hogged by taking the Ground.

or carpenter's ways, it may be plainly perceived how much the middle of their long straight floors are hogged upwards. And when they happen to be laid a-dry upon mud or sand, which makes a solid resistance against the long straight floors amidships, in comparison with the two sharp ends, the entrance and run meet with little support, but are pressed down lower than the flat of the floor, and in proportion hogs the ship amidships, which is but too well known from experience, to occasion many total losses, or do so much damage by hogging them, as to require a vast deal of trouble and expence to save and repair them, so as to get the hog taken out, and brought to their proper sheer again. And to do this the more effectually, the owners have often been induced, to go to the expence of lengthening them; and by the common method, in proportion as they add to the burden of these ships, by lengthening their too long straight floors, in their main bodies amidships, so much do they add to their general weakness to bear hardships, either on the ground or afloat; for the scantling of their old timber and plank is not proportionable to bear the additional burden that is added to them.

BUT defects of this kind are best proved from real and incontestable facts in common practice. At the very time I was writing on this subject, I was called upon for my advice by the commander of one of those strong, long, straight floored ships, who was in much trouble and distraction of mind, for the great damage his ship had taken, by the pilot laying her on a hard, gentle sloping sand, at the outside of our docks at Liverpool, where it is common for ships that will take the ground to lie for a tide, when it proves too late to get into our wet docks. After recommending a proper ship carpenter, I went to the ship, which lay with only a small heel, yet was greatly hogged, and the butts of her upper works strained greatly upon on the lee side, and the seams of her bottom, at the lower futtock heads, vastly opened on the weather side; all which strained parts were agreed upon, not to be caulked, but filled with tallow, putty, or clay, &c. with raw bullock hides, or canvas nailed with battens on her bottom, which prevented her sinking with the flow of the tide, without hindring the pressure of water from righting and closing the seams again as she floated, so as to enable them to keep her free with pumping. This vessel, like many other instances of ships of this construction that I have known, was saved and repaired at a great expence, in our dry repairing docks, as above mentioned. And that their bottoms not only

only hog upwards, but sag (or curve) downwards, to dangerous and fatal degrees, according to the strain or pressure that prevails upon them, will be proved from the following facts.

Observations on long, straight floor'd Ships, stowing and carrying very heavy Cargoes.

IT has been long known from experience, that when ships load deep with very heavy cargoes or materials that are stowed too low, it makes them so very laboursome at sea, when the waves run high, as to roll away their masts, and after that misfortune, causes them to labour and roll the more, so as to endanger their working and straining themselves to pieces, to prevent which, it has been long a common practice to leave a great part of their fore and after holds empty, and to stow them as high as possible in the main body amidships, which causes the bottoms of these long straight floored ships to sag downwards, in proportion as the weight of the cargo stowed there, exceeds the pressure of the water upwards, so much, so as to make them dangerously and fatally leaky.

I HAVE known many instances of those strong ships of five or six hundred tons burden, built with long straight floors, on the east coast of England, for the coal and timber trade, come loaded with timber from the Baltick to Liverpool, where they commonly load deep with rock salt, which is too heavy to fill their holds, so that for the above reasons they stowed it high amidships, and left large empty spaces in their fore and after holds, which caused their long straight floors to sag downwards, so much as to make their hold stanchions amidships, at the main hatchway, settle from the beams three or four inches, and their mainmasts settle so much as to oblige them to set up the main rigging when rolling hard at sea, to prevent the masts being rolled away, and they were rendered so leaky as to be obliged to return to Liverpool, to get their leaks stoppt at great expence. And in order to save the time and expence in discharging them, endeavours were made to find out, and stop their leaks, by lying them ashore dry on a level sand, but without effect, for though their bottoms were thus sagged down by their cargoes when afloat, yet, when they came adry upon the sand, some of their bottoms hogged upwards so much as to raise their mainmasts

On their loading with rock salt.

mainmasts and pumps so high as to tear their coats from their decks, so that they have been obliged to discharge their cargoes, and give them a repair in the repairing dock, and in some to double their bottoms, to enable them to carry these cargoes with safety, stowed in this manner. From this cause I have known one of these strong ships to founder.

AMONGST those ships which have put back to Liverpool to get their leaks stopt, there was a very strong looking ship belonging to Whitby, with a brave resolute commander, who told me in conversation, that when his ship's leaks were stopt, he did not doubt but to be able to beat a passage out of our deep bay even against westerly winds; not considering, that though his ship was made tight by being new calked, yet she carried the same defects with her to sea the second time, where they kept beating to windward against westerly winds till the ship foundered, when the worthy commander and his brave crew were obliged to take to their boats and attempt to save themselves, but unfortunately they all lost their lives in endeavouring to land upon the lee shore.

MANY other ships have met with loss and damage from the same cause of loading rock-salt too high amidships, but two in particular. One that proceeded to sea on her voyage since this last mentioned, foundered, but the crew fortunately saved themselves in their boats. The other when loaded in one of our wet docks, became so very leaky that they thought it must be some stone in the dock that had damaged her bottom, they discharged and put her into one of our repairing docks, but found no other cause but what I told the captain arose from her bottom being over fagged down, and it would be the same again if he stowed the cargo in the same manner, but he said he would take no more in than would ballast her.

AMONGST the many instances of ships that have been distressed by carrying cargoes of lead, one failed from hence bound to Marfeilles, which was soon obliged to put back again in great distress, having had four feet water in the hold, by the commander's account, owing to the ship's bottom sagging down to such a degree as made the hold stanchions settle six inches from the lower deck beams amidships; yet it is common with these long straight-floored ships, when these heavy cargoes are discharged that make their bottoms sag down, then to hog upwards, so that when they are put into a dry repairing dock, with empty holds, upon straight blocks, they commonly either split the blocks close fore and aft, or damage

*On their
loading
with lead.*

damage their keels there, by the whole weight of the ship lying upon them, when none lies upon the blocks under the flat of their floors amidships, that being hogged upwards; which was the case of this ship's bottom; though fagged downwards six inches by her cargo, it was now found hogged so much that her keel did not touch the blocks amidships, which occasioned so much damage to the after part of the keel, as to oblige them to repair it; which is commonly the case with these ships, and therefore deserving particular notice.

Those facts prove the necessity of having and observing nicely what I call a ship's form gage, which will be recommended and described hereafter.

On long straight floored Ships going into repairing Docks.

I HAVE known many instances of hogg'd bottom'd ships like this last mentioned, that have been strained and hurt by being laid upon straight blocks, or else have split the blocks under the fore and after part of the keel. Some even have been obliged to dock the second time, and to have the blocks laid with the same convex curve that the hog of the bottom and keel has acquired. And we have several ships belonging to Liverpool, that are obliged to have their blocks laid in this manner, according to the known fixed hog of their bottoms.

To prevent the necessity of laying blocks for hogged ships in a convex manner as last mentioned; I lately saw an instance of a large long floored ship of about 700 tons, that had a good sheer in her upper works, but her bottom and keel amidships was hogged about eight inches in the middle of her long floor, and they had cut away the first keel from eight inches deep amidships, by a straight line to nothing, fore and aft, and had put a proper straight keel below it, which made her sit fair and easy upon the straight blocks.

THESE important and destructive facts, must be allowed to deserve particular notice, and our utmost endeavours should be used to prevent as much as possible, the damage done by our ships' bottoms hogging upwards; and the dreadful distresses and loss of such valuable lives and property occasioned by their bottoms sagging downwards; which in my opinion is entirely owing

On Ships with bottoms forming an arch downwards.

to the common, but destructive methods of building, and stowing them with very heavy cargoes or materials, as has been mentioned. And first to prevent our ships' bottoms from hogging and straining so much upwards, I recommend to build them with a small curve lengthways in their bottoms, rounding downwards, convexly.

To build Ships with bottoms to form an arch downwards.

I HOPE enough has been said to make it appear evident to every reasonable and discerning man, that whether ships are designed to be built with flat floors and floorings for stowing or carrying great burdens, or sharp short floors and floorings, for sailing fast, they should all be built with their floors and bottoms lengthways, to form an arch with the projecting part downwards, which will naturally not only contribute greatly to prevent their taking damage by their bottoms hogging and straining upwards, either aground or afloat, as has been mentioned, but will, among other advantages, be a help to their sailing, steering, staying, and wearing; for it is well known that water acts and reacts, by its pressure, exactly opposite, on certain principles, in proportion as it is acted upon, so that when any body of a convex form, though heavier than water, is forced with great velocity, in a flanting direction, into the water, when its surface is smooth, the reaction of the water will make it rise out of it into the air several times, and make what is commonly called, ducks and drakes. Even a round iron cannon ball, though eight times heavier than its bulk of water, when shot in that flanting direction into the water will rebound, and rise out of it, and make ducks and drakes before it sinks, nearly as far as the range of *one* shot from a small elevation. And that cannon shot will rebound, and rise about a man's height out of the water, I can aver for a fact; having had a narrow escape standing in a boat's stern-sheets, going to attack a ship. I saw the shot first graze the water right a head of us, and then rise and go directly over our heads, and make ducks and drakes right a stern of us.

AND no doubt but water will act with the same natural principles upon ships that have their bows and entrance formed with circular convex curves, and their floors to form an arch downwards in the length of their bottoms, as recommended, and represented

presented Plate the first, so that when they are forced forward through the water with a swift progressive motion by great pressure of sail, *that*, dividing and sinking the particles of water for the fore body of the ship to make a passage through them, the reaction of the water, as above observed, will tend to lift and lighten upwards the bodies of ships thus formed, and thus lessen their resistance through the water, which must help their sailing, and prevent greatly their bows being plunged deep into the waves, when obliged to carry a pressing sail in bad weather. And the water will act, as observed page 13, with its power of pressure upwards greatest against the lowest part of these ships' bottoms, under the midship, or main frame, which is the main body of the ship, where, the center of the greatest cavity, and the center of gravity of the ship and all that she contains in and about her, as well as the center of all her turning motions, which must naturally contribute to make her more manageable to steer, stay or ware to the greatest advantage. And these are very important properties for a ship to have; especially the last, which is most wanted in times of greatest danger:---when ships will not stay, to ware readily may be the saving of the whole.

OTHER advantages attend these bottoms: by working the keel with a curve downwards on the upper part, it admits of the floor timbers to lie so much farther fore and aft upon the keel without deadwood and chocks under them, to form the entrance and run of the ship in a more natural, easy, simple manner, to make her stronger and more buoyant, to stow and carry more with less timber, iron, and workmanship; consequently they may be built cheaper and better than straight floored ships can be.

AND this form for ships' bottoms seems pointed out to us by the All-perfēct Author of nature: for all flat and straight parts in the main body of a ship offend the eye and disgust us, when that agreeable curve or sheer of a handsome ship's bends and upper works pleases, and makes us say that she swims like a duck upon the water. And all the swiftest fish we see in motion at sea, as well as the fowl which swim and dive in water for their prey and subsistence, have all their bellies (which may be called their bottoms) formed with a curve rounding downwards, till past their main breadth, as here recommended for ships' bottom, where, I reckon, the resistance of the water ceases with its tendency to lift the ship's fore and main body (as before mentioned), after which it may easily be perceived that the water, which must rise and close upon the

tapered after-body and run of the ship by its pressure to come to its natural level again, must act with its power to help a ship forward in her progressive motion through the water, in proportion as it is well formed for that purpose, which will be noticed hereafter.

THAT these curved bottoms will have the advantage in sailing, is further confirmed by the practice of building all our famous sailing, smuggling and cruising cutters, at Folkston, upon this principle; and, in my opinion, they carry this curve of the bottom to an extreme. We had one built for a privateer at Liverpool, of sixteen nine pounders, by a draft of one of the most famous-sailing cruising cutters in the King's service. She had not only the curve of her sharp floor in her bottom, but her keel, 58 feet long under her main frame, was curved downwards 8 inches, so that they were obliged to lay the blocks for her with the same concave curve in the dry dock, to sheath her with copper after she was launched.--My opinion of this bottom was asked by the ingenious drafts-man. I told him that the curve of her bottom and keel was carried to an extreme; for in case of coming aground and adry, as all vessels are liable to in our tide ways, she would naturally strain for the want of the necessary support of her keel upon the ground fore and aft; and this, and the great rake of her stern-post were the two things that I disliked. He answered this was done to make them sure and quick in staying in very little room, which must be allowed would help that necessary property for smuggling vessels, and those that are to cruise after them in dangerous narrow channels, creeks, and corners where they frequent: but this property is not so necessary to a vessel that is to cruise in the open sea, therefore a straighter keel below, and an upright sternpost, would certainly have been an advantage to her. The friendly debate was concluded by his observing, that he was not at liberty to deviate from the draft of the famous-sailing vessel above mentioned.

THE difference of these, being so great and various, made me very inquisitive about the properties of a ship built at Liverpool for the Jamaica trade, with both stem and sternpost standing upright, perpendicular to the keel. The report I had from the commander of this ship was, that her sailing came far short of what was expected from the appearance of her bottom; and that before they altered, and raised her abaft, so as to stow more goods there, and so as to trim her to sail two and a half feet by the stern, she often refused either to stay, or ware equal to other ships in company; for whatever makes a ship gripe, or carry her helm too much to windward when sailing upon a wind (as this upright stem did) must naturally be a hindrance to her sailing, steering, staying, or waring, by the rudder being so much more a stop-water to her head way; and as they were obliged to trim her so much by the stern, it hindered them the more in proportion to heave up their anchors from under her keel, or forefoot, which made it very dangerous to get her fairly underway in narrow waters, and increased her draught of water. These important defects may all be imputed to the upright stem, which ought to be condemned in practice, and we should endeavour to fix a rule to give it a proper rake, as will be mentioned hereafter, which among many other advantages, admits the anchors to heave easily up, clear of the forefoot, so that a ship may be got the readier under way, in narrow waters, which is of great importance to avoid dangers.

I HOPE there has been enough said to condemn the practice of building ships with upright stems. Yet I approve and recommend to build them with upright sternposts, for there cannot be a more certain proof of its being a wrong practice to build ships, and especially full ships, with raking sternposts, than the expensive method commonly practised to mend the defects of the bad steering of such. They are obliged to take off their rudder-bands, and add as much tapered post as can be well fastened to the after part of the mainpost, to bring the after part as near upright as they can, which has been known to be of great service on this occasion and evidently points out that all ships should be built with the after part of their sternpost upright, perpendicular to the keel, which gives the utmost possible length and regularity to the ship's run, acts as a lee-board to help her sailing to windward,
and

Observations on the Bows and Buttocks of Ships.

and gives the utmost possible power to the helm to steer and manage her to the greatest advantage on important occasions.

Observations on the Bows and Buttocks of Ships.

A Remarkably great difference may be observed in the curvature of the bows and buttocks of ships, and the effects of them at sea, which I have experienced from the over-full bowed collier, (which the seamen used to say would drive a t---d before her bows a mile, before it could get clear of them,) to the over-sharp bowed ship formed like a wedge, that would not bear to carry a reasonable necessary pressure of sail upon a wind in a rough sea, without plunging her sharp bows and forecastle so dangerously deep into the sea, as to fill her main deck, full and full, with water, which not only deadened her head way so as to hinder her sailing, but strained and filled her with water to such a dangerous degree, as to oblige us to shorten necessary sail, and add bailing to pumping, to save her from sinking on such occasions.---The buttocks as well as the bows deserve particular notice, for if they are built too full in proportion to the bows, at the load or sailing mark, they will tow a great deal of eddied, or what is called, dead water after them, which not only hinders both sailing and steering, but in bad weather, when the waves run high, they lift the stern and plunge the ship's head too much into the waves in proportion, when necessity obliges to carry a pressing sail, and make her to ship a great deal of water, which is both dangerous and injurious to sailing, as has been observed; and if the main transom be too broad and lies too low, it increases the bad effects in proportion.

BUT all defects of this kind are best proved by facts, and from experience. In the war 1745, I was in a fine frigate-built ship for the Leghorn trade, that carried twenty six pounders on her main deck, and went a cruising in the Mediterranean, but she having too full buttocks in the water, as above described, this, as I reckoned, hindered her sailing to expectation, and having a very sharp concave, entrance below, and a pretty full harping above, occasioned her to have a very bad jerking, destructive, pitching motion, when obliged to carry any thing of a pressing sail in a rough

rough sea, and always put our masts in great danger of being pitched away.

YET the buttocks, as may be observed, are often built too sharp at the load mark in proportion to the bows, which appears to me evident from the many ships that have been built what are called full bowed and clean tailed ships, which mode of construction has had a great run in practice, and therefore deserves particular notice.

FULL bows and clean tails, as they are called, I observe has been carried to the extreme in constructing ships for the coal trade, and in some capital merchant ships built lately, which method reason as well as experience shews not to be attended with the advantages expected from it, for their over full bows, especially when loaden, as observed of the colliers, always drive a great swell of water before them, which, as they may be said to be always sailing up the hill against the swell of water, not only obstructs their sailing through the water, but hinders their steering even in fine weather and smooth water; and in bad weather, when the waves run high, puts it out of the power of the best helmsmen to steer them near their course, and when sailing before the wind at such times, they are very liable to broach too, and the opposing and lifting property of their broad bows, in proportion to their thin tails, (especially if they have narrow transoms,) makes them very liable to be pooped; and in lying to, plunges their counters and sterns dangerously deep into the sea, and makes them ride very hard upon their cables at an anchor at such times.

I experienced the same defects, from the same cause, though in a less degree, in a codsmack which I got built with full bows, a clean tail, and a narrow transom, according to a draft drawn by a famous ship-builder in London; which I got improved upon, by causing an ingenious builder at Liverpool to build another of the same dimensions, but with somewhat sharper bows, and more middling-full buttocks, suitable to each other, at the water's edge, and a broader transom, which had the designed effect, and gave her the advantages of being both a better sailer, and a better stormy weather vessel, than the other, which codsmacks require to be, for they are obliged to lie to, to catch their fish, and to beat the sea in all weathers possible to get them alive to market.

THIS evident improvement upon the clean tailed vessel, and the experience I had afterwards in a privateer built by the same man, 1756, for a common merchant ship, with what I call middling full

Observations on the Bows and Buttocks of Ships.

full bows and buttocks, answered the purpose so well in sailing, that the success attending it excited me to present him a piece of plate, with a suitable motto, “*as a grateful acknowledgement to Robert Brekel, &c.* whose name I think justly deserves to be recorded for building good sailing merchant ships. And other merchant ships built since by him and by other builders at Liverpool, with middling full bows and buttocks, have been remarkably successful as cruisers in the war 1778, in distressing our enemies and enriching ourselves; and have, by fair sailing in chase, taken several of the enemies sharpest built vessels, which have been constructed for sailing only, with their bows and buttocks formed like wedges, which only answers the purpose of sailing fast in fine weather and smooth water, but not in rough winds and waves, when, as observed page 21, middling full bowed and buttocked ships will have the advantage of them.

THESE instances may be added to those I mentioned in the former edition on the difference of strong, middling-fall built ships, and very light sharp ships' sailing. In the war 1746, I was in one of our East India ships, which was fitted out for a cruising ship, and was taken by a French squadron of sharp Toulon built ships in little winds, but afterwards, when it came to blow so strong as to put us under clove reefed topsails, our vessel could be the headmost and weathermost ship of their fleet.

A LITTLE time after this I got the command of a very extraordinary sharp, slight, ship, built at the Island of Malta, with very small scantling of timber and plank, long, low, and narrow, being only 27 feet beam to 88 feet keel, with shelving shallow, sharp main body, bows, and buttocks, for a cruising ship, which purpose the answered extraordinary well in little winds, fine weather, and smooth water. In chasing large, in little wind and a head swell, we have steered right up to the chase, when all their endeavours could not keep their ship's head to the swell, but lay broad side to it. A small pressure of wind and sail would put this shell of a ship to her utmost speed, so that we never desired the wind to blow with a greater velocity than about ten miles an hour, when, I reckon, a middling stiff ship can just carry top gallant sails upon a wind in smooth water, which weather gave us the greatest advantages in sailing, compared with other ships, in chase, to take or leave the enemy at pleasure. But in tacking her, when it blew so fresh that we could just carry whole topsails, we were obliged to haul up our courses to make her sure in staying, otherwise

ways she would get such stern way before she brought the wind a-head, as prevented her staying. This bad property I attributed to the lightness and length of her body in proportion to her breadth, that could not bear so much sail a-back in the long time she took to bring the wind a-head.

In cruising with this weak ship, it often happened that we fell in with our cruising strong ships of war, who naturally gave chase to us, and we to them, till we knew them; when commonly we made sail and steered from them, and left them with ease in light winds till we lost sight of them. But once it happened in a fresh gale, that we run before the wind in chase within about two miles right to windward of one of our seventy gun ships, which was in chase of us, when we hauled the wind, the sea being smooth, thinking to out sail them as usual, but we could only carry close reefed topsails, when they out carried us with sail, and gained upon us to windward, and would have brought us to in spite of our utmost endeavours, if we had continued sailing close by the wind; but the weather gage we had, admitting us to sail a point or two from the wind, that gave us the advantage of leaving them by sailing large. And we met with one of our King's twenty gun frigates that was fully a match for us in sailing large in a gale of wind. I mention these particular circumstances relating to this ship, in order to invalidate that notion of a ship sailing faster by being made weaker; for this ship was so weak that, in bad weather, when the waves run high, we could hardly keep her together, and in chasing to windward at such times she used to plunge her over-sharp bows so deep into the waves, as to oblige us to shorten sail, and add bailing to pumping to save her from sinking, so that if the chase had known our condition, and kept their wind, they might have saved themselves from being taken; but they bore away before the wind, which gave us the advantage to take them, and then we were obliged to run before the wind to a road-stead to stop our leaks, and to go to the Island of Malta, to get the vessel repaired and strengthened.

THESE facts, related from experience and observation, evidently prove, that there is a medium between these extremes of the great diversity and opposite forms of the bows and buttocks of ships, which would answer best in all weathers in general, and which certainly ought to be aimed at by some fixed rule, to prevent as much as possible such important defects as have been mentioned by their being too full or too sharp, and to proportion them to each other

other to the greatest advantage for a ship's sailing, not only in fine, but in rough and bad weather, on important occasions, and to be lively and easy in the sea when the waves run high in a storm, when put past carrying sail, but obliged to lie to, or come to an anchor and ride hard upon a lee shore, &c. having no head way, and when lying to as in common, with the helm a-lee, they get stern way, or when waring or scudding before the wind in a storm, at which times all ships require to have what I call a middling broad transom, and a moderate spreading buttock at the load mark abaft, to buoy up and to prevent their being pooped, and the most weak and dangerous parts of a ship, the counter and stern, being liable to be stove in by the power of the waves striking against them. And not only on this account of making ships safer and better bad weather vessels, as last mentioned, but to make them sail faster in general, I cannot help thinking but that they require rather fuller buttocks than bows, in the water lines at their load marks, at the sternpost than at the stem; for it should be considered that it is the bows entrance, and fore body of the ship that have to divide and sink the particles of water to make their passage through it, with the least possible resistance, and as the particles of water near its surface are easier divided than sunk, the bows should be formed sharper than the buttocks, that the impulse of the wind or waves may force the ship forward the easier in her progressive motion through the water, the resistance of which ceases at the midship or main frame, where the water begins to rise and close upon the tapered after-body of the ship, with a tendency to help her forward in her progressive motion, and the buttocks spreading rather fuller than the bows at the water's edge, the water will act with more power by its pressure upon the buttocks, if well formed, not only to steady and support the ship abaft in a rough sea, as has been observed, but to increase her progressive motion when sailing fast. And this is farther confirmed from experience in those famous-sailing, sharp built vessels, called cutters, by the necessity they find themselves under to trim them four or five feet, or more, by the stern, even till they bring their square tucks deep in the water abaft for their best sailing trim.

So that our fastest sailing vessels may be said to be just the reverse of the full bowed and clean tailed ships, and to have clean or sharp bows, and full tails or buttocks in their water lines, at their best sailing trim, and square tucks deep in the water, must certainly tow eddied water after vessels and retard their sailing much
more

more than circular formed buttocks would do ; which various and opposite extremes in forming the bows and buttocks, and those other important defects arising from the bad principles of their construction abovementioned, may no doubt, in a great measure be avoided, by fixing on some such as the following natural rules, which I humbly offer to give hints for, endeavouring to point out how ships in general ought to be built to answer their designed purposes to the greatest advantage, from what has occurred to me from reason, experience, observation, and conversation.

Hints towards fixing Rules, for the best Construction of Ships' Bottoms.

I WOULD recommend, to prevent Ships' bottoms from hogging upward amidships, as has been mentioned, to have the fore and after part of the keels deep enough, that the upper part may be made to admit a rabbit for the garboard streak, that the main body and bearing part of ships' bottoms may be made to form an arch downwards in their length, suppose with the same sheer as their bends, at the rate of about two inches for every thirty feet of the extreme length of the keel towards the midship or main-frame, which may be reckoned the crown of the arch ; and the lower part of the keel to be made straight, but laid upon blocks so that it may form a regular convex curve downwards at the rate of an inch for every thirty feet of the extreme length of the keel, the lowest part exactly under the main-frame ; which curve, I reckon, is only a sufficient allowance for the keel to become straight below, after they are launched afloat, by the pressure of the water upward against their floors amidships, as mentioned page 12, which causes their tendency to hog. And certainly a straight keel is a great advantage in failing, as well as to support them when laid upon level ground, or on straight blocks in a repairing dock, without taking damage, as observed page 17, 18, and 19.

2d. As square sterned ships, from experience, are formed to answer all trades and purposes better than round or pink sterned ships, I would recommend the fore part of the sternpost, on account of drawing the water-lines in the draft, only to have a few inches rake, that the after part may stand quite upright and perpendicular.

cular to the keel, for reasons given page 21 : and for the rake of the stem I would purpose the rabbit for the hudding ends for the entrance and bows from the keel upwards, to form the same curve as the water-line from the stem at the harping towards the main breadth, and the bows at the harping to be formed by a sweep of a circle of half the three fourths of the main breadth ; and the main transom to be three fourths of the main breadth ; and the buttocks, at the load or sailing mark aft, to be formed, the same as the bows at the harping, with a sweep of a circle of half the three fourths of the main breadth, to extend just as far from the stem and sternpost as to admit a regular convex curve to the main frame, and thence down to the keel to form regular convex water-lines, without any of those unnatural hollow, concave, ones, either in the entrance or run : which rules in my opinion will agree with the main body of the ship, whether she is designed to be built full for burden, or sharp below for sailing ; as represented by a Frigate's hull, plate 1. which I got drawn by my friend Thomas Mitchel, Esq. a navy surveyor, to answer the purpose of a cruising, or trading ship, and had a building draft drawn to it by my late ingenious friend, Capt:in Joseph Taylor, who had talents and a turn of mind for such noble purposes as this was designed. The ship was intended to be built by subscription, to cruise against our enemies, and the draft was well approved of by our most ingenious draftsman and builder, Robert Brekel, before mentioned.

3d. This rule for raking the stem will admit all the water lines in the ship's entrance to form convex curves all the way from the stem to the midship or main frame, which answers much better for sailing, as well as making a ship more easy and lively in bad weather, than those unnatural, concave, hollow entrances, which occasion such destructive pitching motions, as mentioned page 22. And the bows should flange off, rounding in a circular form from the bends up to the gunwale, in order to meet the main breadth the sooner, with a sweep of half the main breadth at the gunwale amidships, which will not only prevent them greatly from being plunged under water in bad weather, but spread the standing fore rigging the more, to support these material masts and sails forward to much greater advantage than in those over sharp bowed ships, as has been mentioned. And as the sailing trim of ships in general is more or less by the stern, this makes the water-lines of the entrance in proportion the sharper, to divide the particles of water the easier, so

so that the ship may pass through it with the least resistance, as more particularly mentioned in page 26.

4th. THE run ought to be formed shorter or longer, fuller or sharper, in proportion to the entrance and main body, as the ship is designed, for burden or sailing fast. The convex curves of the water-lines should lessen gradually from the load or sailing mark aft, as has been mentioned, downwards, till a fair straight taper is formed from the after part of the floor, to the stern-post below, without any concavity in the water-lines, which will not only add buoyancy and burden to the after body and run of the ship, but, in my opinion, will help both her sailing and steering motions; for the pressure of water as it closes and rises upon it to come to its level again, and fill up that hollow which is made by the fore and main body being pressed forward with sail, will impinge, and act with more power to help the ship forward in her progressive motion, than upon those unnatural concave runs, which have so much mere flat dead wood, that must, in proportion, be a hindrance to the stern being turned so easily by the power of the helm to steer the ship to the greatest advantage. And since writing my Second Edition, where finding fault with too sharp buttocks, I have observed several ships fill them up, to avoid the great danger they have found, being liable to, from experience of being pooped, by which one of our ships called the Backhouse, James Collinson, Master, and crew received very great damage, and had a very narrow escape from foundering, which was published in our newspapers.

SOME such plain simple rules as these, which nature, reason, and experience evidently point out to us, ought to have a fair trial in drafting and constructing ships, and to have their good or bad properties justly observed and compared with other ships of different construction, when they are as near as possible under the same circumstances in practice, by which means standard rules may be fixed for the best and only construction for ships, as there can be but one form that will answer best; otherwise we might suppose they would all answer equally well.

BUT it must be allowed, that building ships upon this principle, with their bottoms curved in their length downwards, only prevents their hogging and straining upwards, but does not prevent their sagging and straining downwards, which all ships are liable to do to dangerous and fatal degrees, when very heavy ballast, cargoes, or materials are improperly stowed by the common method,

On proportionable Dimensions for Ships.

thod, too much in the main body of the ship, so as frequently to occasion great damage, and fatal loss of property and lives, as particularly mentioned, page 16; which certainly deserves our utmost endeavours to prevent as much as possible. For this purpose I shall venture to propose a different method of stowing these heavy materials, regulated by the help of what I call a ship's Form-Gage, which may easily be fixed in the manner hereafter described, for a guide, to prevent ships' bottoms from being hogged, upwards, or sagged downwards, by improper stowage, and to keep their bottoms nearly in the same form in which they were built, and thus to make them less liable to labour and strain to such dangerous and fatal degrees in high waves at sea, as before observed.

On proportional Dimensions for Ships.

AS the comparative good or bad properties of ships for sailing, steering, staying, or waring, as well as their being lively and easy at sea, and proceeding with safety, free from the great danger of their being too crank and liable to overset, or being too stiff and laboursome, as it is called, (which makes them roll so deep into the sea, and with so quick motions as to roll away their masts, not only in bad weather, when the waves run very high, but in fine moderate weather, when there often run long swells of waves,) as these, I say, depend on the proportional dimensions of their length, breadth, and depth, being properly or improperly adapted to each other, the subject must be allowed to be of such importance as to deserve particular notice, and our utmost endeavours to fix upon some rule for a medium that may come nearest the best dimensions for the different trades, or purposes, they may be designed for.

As a seaman I venture to give my remarks on the subject, having observed, when sailing, that vessels and ships which are first built, or lengthened, too long in proportion to the breadth, are bad to steer, stay, or ware on necessary occasions. And when built too high, in proportion to their breadth, it makes them so crank as to be in danger of oversetting, as proved to be the case with one in consort with me, and was fatal both to ship and crew. I judge this therefore the more dangerous of the two extremes; and as these vessels require to be set so much down in the water by an

On ships
too long.

an extraordinary weight of ballast, goods, or heavy materials before they are sufficiently stiff to carry sail, this is a great hindrance to their sailing in general, but especially upon a wind, as it is known from experience that many a fine bottom has been spoiled for fast sailing, by having too great a top built upon it, which, as I have been told by ship-builders, is owing to that unfair and erroneous method of calculating their tonnage for measurement by half the breadth for the depth, for payment, instead of the whole depth they are built; which latter practice ought in justice to take place between the builders and owners, to be a check upon owners who want unproportional height, in order to gain more stowage and accommodation for people and passengers, &c. by which their ships are made defective in those important points abovementioned.

I have heard that a master of a crank ship, used to say when it blew fresh, sailing by the wind, her trim was to sail with the lee windlasses end in the water, which must be allowed to be a bad property. And I have known many instances where owners of ships have been at great expence, to reduce their ships that have been built too high, to more proper proportional dimensions according to their breadth.

We had a late fatal loss of a large new frigate on her first voyage, which had overset with upwards of five hundred slaves, and her crew all drowned except two seamen and three slaves; which added to the many other such instances, proves the necessity to endeavour to get such general rules fixed to prevent as much as possible such dreadful losses; for this ship, when launched overset and sunk for want of more beam and a fuller bottom to support her over high proportional built top; for we should always aim to make ships just stiff enough to carry away their masts before they overset, which makes the most compleat structure and trim they can be brought to; which I have been long endeavouring to do.

On Ships being too stiff and laboursome at Sea.

I SPEAK from experience in one of our Government old 20 gun ships called the Leostoff, which we bought, and fitted out with lighter guns and materials than she formerly carried, and loaded her with a general cargo of different sorts of goods for the West

West Indies, yet she was but fourteen days at sea when down came our main yard upon deck, occasioned by the new main-tye being chafed to pieces in the middle or inside of the rope, by the strands rubbing against each other from the ship's extraordinary deep and quick rolling motions, which soon wore out the other new rigging, and worked loose her hull in proportion.

In a passage from Jamaica, with quite a full ship, we have rolled away a new set of main laniards in one night. In a passage to Leghorn, loaden with lead, leather, &c. we stowed the lead upon a great height of leather, which was screwed down with boards upon it, in order to keep the ship tolerably easy at sea, and to prevent the damage that might be done by her bad rolling property. This answered the designed purpose very well the first part of the passage, till, by her labouring, the weight of the lead pressed the leather lower; and hence the latter part of the passage she became so laboursome as to roll away two topmasts, in spite of our utmost endeavours to save them. When loaded with a cargo of wheat from the Gulf of Venice, to Cadiz, we stowed it close up to the main deck in the main body of the ship, to prevent her rolling, yet sailing before the wind in fine weather, carrying studding fails and topgallant fails in company with other ships, when only a long swell of a following sea has come on, it obliged us to take in our studding fails and topgallant fails, and to lower our topsails half mast, to prevent the topmast being rolled away, when the other ships carried all their small fails without any danger of their masts, from rolling.

THESE facts make it evident that this ship's decks lay too low in proportion to her breadth, for a merchant ship, to stow and carry cargoes in general to profitable advantage, and was only fit for her first design, to carry and support heavy guns, masts, yards and materials, which would naturally keep her more easy at sea, and prevent rolling to such destructive degrees; not only the masts, sails and rigging, &c. (as hath been mentioned) but the hull is worked loose and made leaky by it, and when it happens that such vessels lose their masts and heave their guns overboard, when the waves run high, it occasions their rolling the more in proportion, for want of their masts and guns to counterpoise and keep them more easy in the sea, so as to endanger and often to occasion their foundering. Such fatal consequences made me think that this ship's decks were laid too low in proportion to her breadth, even for a ship of war, which I reckon would be sufficiently stiff if the would

would bear to carry away her masts before she is pressed down on her broad side so as to overset her, which is the medium that should be aimed at between this and an over crank ship, in which when pressed down on her side by the wind or waves, instead of the danger of carrying or rolling away her masts as abovementioned, her rolling motions are comparatively so slow and easy in coming upright again, that the greatest danger is apprehended from her not rising, but oversetting.

But these very stiff laboursome ships must be allowed to have an advantage of bearing to carry a more pressing sail upon a wind with an upright side, in comparison with the crank ship that goes heeling much along upon her side at the same time. And they will shift themselves, without ballast, as was the case with the abovementioned ship; for we have lain safely in an open roadstead, with our topmasts up and our guns upon deck, with a clean swept hold, ready for her cargo.

Hints towards fixing Rules for the best proportional Dimensions of Merchant's Ships in general, for Length, Breadth, and Depth.

HAVING given reasons and hints towards fixing rules to form the bottoms, bows, and buttocks of merchant's ships, I venture, for the reasons last assigned, to give hints to fix rules in general for the best dimensions as to their breadth and depth in proportion to their length.

HAVING recommended, for reasons given, the after part of the sternpost to be upright, which adds some length to the keel above common, I recommend the main or midship frame to be a third of the length of the keel, and to be laid seven twelfths of the length of the keel from the after part of the sternpost, and the depth of the hollow from the main or gun deck to the ceiling at the midship or main frame, to be six tenths of the main breadth. For instance, suppose a ship is to be 90 feet keel, this gives 30 feet beam; the tenth part of that is 3 feet, and six times 3, gives 18 feet for the depth of the hold or hollow, from the main or gun deck amidships, to the ceiling, and the lower beams or lower deck may be laid higher or lower as may best answer strength, stowage, or other advantages for the trade or other purpose the ship may be designed for. The same rule naturally points out that the length-

of the keel should be three times the breadth of the beam, by which the stowage, burden, and value of the ship is to be calculated. And it may not be amiss, if, in addition to these proportional dimensions, the hints which have been given at large for rules to form the bottoms, entrance, runs, bows and buttocks of ships, be here briefly repeated, in order that the proposed form of the whole ship may be the better understood.

HERE begin with the last proposed general rule for the proportional dimensions, recommending the after part of the stern-post to be upright, and the length of the keel to be three times the breadth of the beam, and the depth of the hold or hollow to be six tenths of the main breadth at the midship or main frame, which I would have to lie seven twelfths of the keel from the after part of the stern-post, where I would propose the middle and lowest part of the floor and main body of the ship to form an elliptical arch, or curve, in her length downwards, as recommended page 18.

For example, suppose the last mentioned designed ship of 90 feet keel and thirty feet beam, the main frame is to lie between the two lowest dead flat floorings 7 twelfths, that is, 52 and a half feet from the after part of the stern-post, there to be six tenths of the breadth of the beam, that is, 18 feet deep in the hold, or hollow from the main or gun deck to the ceiling, and the hold beams, or lower deck, to be laid higher or lower as the stowage and trade may require. And to curve the bottom to form an arch in its length downwards as has been so strongly recommended for the important reasons given, I would propose the upper part of the keel with the groove for the garboard streak to be made to form a convex curve of six inches under the midship or main frame, and the lower part of the keel to be straight, but laid upon blocks forming a concave curve of three inches, or of one inch for every thirty feet in the extreme length of the keel, under the midship or mainframe, which, for the reasons given, page 12, I reckon in this length of keel will soon become straight enough to fit easy and support the ship on straight blocks or level ground, as occasion may require.

To form the entrance and run of this ship by the rules laid down, page 28; 22 $\frac{1}{2}$ feet is her breadth at the main transom, three fourths of her main breadth, and the water line of the bow at the harping or upper part of the bends, as well as the buttock at the load mark aft, is to be formed by a sweep of eleven feet three inches, half the length of the main transom, just as far from the stem and stern-post as to admit to form a regular convex water-line

line curve to the midship or main frame. And the rake of the stem is to admit the rabbit for the hudding ends of the bow and entrance to form the same curve from the keel upwards, as the water-line from the stem at the harping towards the main breadth. And from the huddings at the stem of the entrance, as well as at the stern-post in the run, all the water-lines should form regular convex curves to the main frame and lowest floorings, which are either long and flat for burden, or rising and sharp for fast sailing; which last must give the advantage, and is absolutely necessary for the slave trade, to shorten the passage by sailing fast when dangerously crowded with slaves. And the bows from the harping should flange up to the gunwale to form the bows with a sweep of a circle of half the main breadth at the gunwale amidships, as mentioned for the reasons given, page 29.

THESE are the hints that have suggested themselves to me from experience and observation, towards fixing some general rules for a standard, by which to construct merchant's ships upon certain principles in general, free from those important defects that have caused, and may still occasion, such dangers, damages and loss, as have been mentioned, and to give them all possible good properties to answer the trade they are designed for, to proceed with the greatest probability of safety and success, and to be lively, dry, wholesome ships at sea in bad weather.

YET before concluding this important subject, it may be necessary to endeavour to answer objections that some may make to the buttocks formed by a sweep of a circle of half the three fourths of the main breadth at the load mark aft, being too full for a fast sailing ship.

BUT I would have them to consider, how such projectile, round, circular bodies, as cannon balls, bombshells, &c. forced into the most violent and swift motion possible through the air, though 800 times lighter than water, admit it to close round behind them, without making a Vacuum, which would instantly stop the great intended range they are thrown to. Upon the very same principle I have very often, for a long time together, observed, (by looking out of the cabin windows of a ship of nearly this construction and trim,) how the circular formed buttocks will admit the particles of water to rise and close round them to the rudder, and to wash or drive off the other particles, so as not to leave any eddied water to be towed after the ship to retard her sailing, or steering motions. And that according to the strength of

Hints to proportion the Dimensions of Merchant Ships.

of the wind, and as the ship is pressed with sail to increase her head way, so much in proportion the bows are pressed down, and the buttocks lifted up, which forms a sharper run for the water to close in upon them more easily when the ship sails fastest. If a ship be under the necessity of carrying a pressing sail against high wind, and waves in a storm, near a lee shore, or lying to, or scudding before the wind for safety, at such times these circular formed buttocks and a fair drawn run (such as have been recommended,) in my opinion will have greatly the advantage of those ships built with very sharp runs, and those unnatural concave hollow water-lines which afford little or no bearing body to support a ship aft, to prevent the stern from being plunged dangerously deep into the waves, which causes them to strike with such amazing and alarming power against that most weak, dangerous, projecting, part about a ship, the counter, against which I have felt such violent shocks as if it would be stove in, or part the stern from the bottom, when the rails of our balcony or stern-gallery have been walked away. For the truth of this defect in such ships I appeal to those birthed in their great cabin or gun-room. These I hope will be thought sufficient reasons for thinking that such circular bows and buttocks as have been recommended, will prove the best medium between the two extremes, of being two sharp, or too full. Of late, I think our builders of merchant's ships, to imitate our King's frigates, have gone much into the extreme, by putting so much dead wood in the run of our merchant's ships near as high as the load mark aft, not considering that the King's frigates are built uniformly sharp for sailing, and have only provisions and materials to carry, but merchantmen have, not only provisions and materials, but full cargos, to carry to make profit by their voyages. And it is well known that dead wood in the run adds no buoyant property to a ship, not even to support itself; for Oak timber, after being sometime soaked in water, will not swim, but sink in it, and using it so high, forms those unnatural hollow concave water-lines as have been mentioned. So much dead wood, it may be justly said, only increases the burden of payment for measurement, but not the tonnage for carrying, nor gives necessary support to a ship's stern and quarters, either a float or lying aground, in comparison with the form of a ship's bottom as mentioned page 19; the run to be formed with a regular fair taper from the main frame to the lower part of the sternpost, the ends of the floorings and buttocks with a regular curve pointing from the keel up, to the load mark, may be said to act in a great measure as spur shores

shores to support the ship either a float or aground, as the frigates and all ships of war are obliged to have them, not only in launching but afterwards, where they few by the tide upon the ground, as at Deptford, till they got to lie afloat. And I have observed almost new, full, and strong vessels strain so much as to make a great deal of water, and oblige them to go into our Graving-Docks to be caulked anew; owing in my opinion to the insufficiency of their runs, being formed mostly of dead wood, to support their stern and quarters, though designedly laid upon hard level ground, where they expected to lie without taking damage.

On Ships with both Bows and Buttocks too full for sailing fast.

BY way of comparison, I refer to those very full, flat floored, Dutch-built ships as they are commonly called, which are formed near to a long square, with two high ends, and very full bows and buttocks. This form must be allowed to give them the advantage of stowing and carrying a great deal of goods, and rendering them comparatively very dry, lively, safe vessels in bad weather at sea, which makes them venture to load them so deep as to leave very little free-board amidships; but then at the same time it must be allowed that they are very slow in their sailing and steering motions, so much so, that I have been surprised at the patience of their commanders, who seemed unconcerned, when we have been sailing so very fast close by them, that our seamen, apt sometimes to be unmannerly, have insultingly called to them to let go their anchor to prevent their going so fast astern.

I HAVE given reasons why an overfull bowed ship is retarded in her sailing motion by driving too great a swell of water before her bows. And in my opinion one great reason why an overfull buttocked ship is retarded both in sailing and steering motions, is because the tows too much eddied, or dead water, after her. For the particles of water certainly have both attractive and cohesive properties, as may be known by observing what a large drop of water will hang perpendicularly at a man's finger end, which proves these particles require force to part them, therefore they must hinder both the sailing and steering motion by cohering to the ship's buttocks and to each other, which prevents the proper effects of the water upon the rudder.

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WE had an instance of one of the first large ships that we had built at Archangel in my time, for the timber trade, that was of this construction of both bows and buttocks being over full, which, with a fine fair wind and weather, with studding-sails and all sails set, could not be steered into Liverpool, but ran on shore against all the power of the helm to steer her, and was lost. For these over full ships, for the reasons above given, lose both their head-way and steerage to command them. And especially when they come into shoal water, as to swell the ground as seamen call it,

On a Ship built by the foregoing Rules, as I recommended.

HERE I conclude this important subject, with noticing the result and success of my endeavours towards fixing general rules for the form, and proportional dimensions, of merchant's ships in general, by giving a detail of a ship that was built for a Nephew of mine, Mr. William Ward, to whom I gave the manuscript which I had wrote upon the subject: he shewed it to his Owners, who approved so much of the remarks, hints, and proposed rules, as to say they wondered that I had not published them before, and they gave them to an ingenious Drafter of ships, Mr. Joseph Elliot, who serv'd his time at the King's Yard at Deptford. He approved of them likewise, and drew the draft according to them, being the Draftsman of Mr. John Fisher, who built this ship in Liverpool, called the *HALL*, of 362 tons, carpenter's measurement, for the Jamaica trade.

I RECKON it owing to her curved main body in her length downwards, and bearing fair drawn run aft, as has been mentioned, that this ship was so buoyant as, when launched, to draw but 7 feet water forward, and 8 feet aft; and only 1 foot by the stern; and when masted and full rigged, with anchors at the bows, &c. to draw but 8 feet 6 inches forward, and 9 feet 3 inches aft; only 9 inches by the stern, with a clean hold. And when full loaded with a Jamaica cargo which was discharged in good order, she drew but 16 feet aft, and 14 feet 9 inches forward; 15 inches by the stern. And all ships should be built, that when launched to swim no more than from 12 to 18 inches by the stern, nearly the same trim as when fit for sea.

In regard to merchant's ships being of a proper stiffness, which I look upon as the most important good, property that can attend them,

them, when built to shift themselves without ballast, and to carry a cargo that is near of an equal weight, that just fills them full when loaded to their load marks, and to be sufficiently stiff to bear a pressing sail by the wind upon necessary occasions, and without being comparatively too laboursome at sea, I reckon then On ships
being of a
proper
killing. they are as perfect in this property as can be expected; therefore this ought to be always aimed at.

THIS ship, though frigate built, with a waist 4 and a half feet deep, and a long quarter-deck and forecastle, went into the Graving-Dock to be sheathed with copper, when full rigged, with top gallant yards up, and a clean hold without any ballast: they then feared she would be too stiff and laboursome, which made me very inquisitive about it. But from the report of her properties, which I think is from undoubted authority, she proves only sufficiently stiff, and comparatively an easy ship in the sea. And I am further assured that she stows, carries, and sails, steers, stays, and wares uncommonly well for such a full built ship; for her long main floorings are so flat as to have only 9 inches rise at her quarter breadth from the middle line, so that to prevent damage to the cargo by such flat floorings, they thought it necessary and fixed two lead bilge pumps, but the ship kept so tight in the voyage that they had no opportunity to try and make a report of their usefulness.

On inquiring of her particular trim for sailing, her commander, who I always found a candid man, said that he could perceive no difference in her sailing, steering, or waring when a foot more or less by the stern; for in going from Kingston, where he discharged most part of his outward bound cargo, to the North side of the Island, she was more than two feet by the stern; and during the whole voyage she still retained her good properties of sailing, steering, staying and waring comparatively well in company with fast sailing ships outward bound. And in their passage home, they came up, and joined company, with a Liverpool ship built for the Jamaica trade during last war, designed for a fast sailing ship to take or leave our enemies; they kept company ten days, and found the HALL had the advantage in sailing both by the wind and large. They then parted in a friendly manner, and she got home four days before the other. These advantageous properties here related, I attribute to those natural reasons given page 18, and particularly that of the greatest pressure of the water acting upwards with its greatest power against the lowest curved part of her bottom.

On a Ship built by the foregoing Rules.

tom under the midship frame, which must in a great measure act to prevent its sagging downward, as well as a pivot, which makes her turn so easy, and be so ready to steer, stay, or ware, though the lower part of the rudder goes no lower than within six inches of the lower part of the keel, which was left to project abaft the sternpost under the fore part of the rudder, to prevent it from being unshipped by striking upon the ground, and ropes for getting into the heel, as I have endeavoured to get represented in the hull of the ship, plate the 1st, figure 1, in which Mr. Elliot, abovementioned, has added sketches of water-lines, and some frame timbers, to a small draft that I had got drawn before, intended the better to explain my ideas, for the best form and proportional dimensions of merchant's ships; a subject which I have been pursuing many years.

THE flanging circular bold form of this ship HALL's bows, gives her the appearance of being, and by report she is, a lively dry ship, forward, at sea, but as the swell of the waves are kept off forward, they close in again about her gang-ways, where the ships the most water and spray of the sea*.

THE tendency of this ship to hog I think deserves particular notice. I saw by the Draft that the buoyant and bearing part of

* As this ship, HALL, answers her designed purpose so well as to give satisfaction both to the owners and crew, it may be well to repeat my proposed rules in figures, that they may be the easier and readier understood by inspection.

Extreme length, or tread, of the keel from the forefoot to the heel at the after part of the sternpost that stands upright, Feet. Inches.
90. 0.

The upper part to be hollowed out with a curve for the garboard break, 2 inches for every 30 feet in length to the main frame, to curve the ship's bottom in length downwards at the main frame, 0. 6.

The bottom of the keel to be made straight, but put upon blocks laid with a concave curve, an inch for every 30 feet, to make it lie with a convex curve exactly under the main frame for an allowance for the tendency of all ships to hog, 0. 3.

Extreme breadth, at the main frame, one third of the length of keel, 0. 3.

Depth of the hollow at Ditto from the ceiling to the main deck, 6 tenths of the extreme breadth, 30. 0.

The main frame to be between the two lower midship floor-timbers, 7 twelfths from the after part of the sternpost, 18. 0.

The main transom to be 3 fourths of the main breadth, 52. 6.

Height of main transom from the upper part of the keel at the main frame to the upper part of the main deck, 52. 6.

Rake of the stem to be formed so as to admit the hudding ends of the entrance and bows to form the same curve as the water-line from the stem at the harping towards the main frame. And this water-line at the harping at the upper part of the bows or the bows, as well as for the butt-socks aft, at the load mark, to be formed from the sweep of a circle of half the 3 fourths of the main breadth towards the main frame from the stem and sternpost, which sweep is from 39. 0.

And the bows to flange out with the rake of the stem, till they are formed by the sweep of a circle of half the main breadth, at the gun-wale amidships at the main frame, for the reasons given.

her

her main body had the same convex curve downwards as the sheer of her bends; but before launching I desired my Nephew to try, with a tight line, how much the bottom of her keel curved downwards under the midship frame, which he did, and found it but 7 eightths of an inch, instead of 3 inches for her 90 feet keel, according to my proposed rule of an inch to every 30 feet in length of the tread of the keel; and to try with the line from a knuckle timber by the stem to the taffarel rail, and make a mark upon the Pole fixed at the fore part of the main hatch-way, to observe, after being launched afloat, if he could perceive the height and weight of the head and stern, having then no bearing in the water to support them, to drop any thing; but he could perceive none; yet when put upon straight blocks in the Graving-Dock to be sheathed with copper to her light water marks, and with wood sheathing to her load marks, she appeared to me to bear harder upon the fore and after blocks than on those amidships.

BUT it was justly observed that these trials should be made by sight, and not with lines, for they always sag downwards. I therefore got Mr. Elliot, the Drafts-man (before her going into the Graving-Dock after a seven months voyage to Jamaica, which must fix the form in which her bottom swam when afloat) to observe from the same knuckle timber forward to the taffarel rail aft, whilst a carpenter's rule put against the side of the mainmast was seen exactly in that line, and a mark made there, when afloat, with a clean hold; and the trial was again made in the same manner, after she came adry upon straight blocks in the Graving-Dock, and this mark upon the mainmast was found an inch and half above the other, by the head and stern being raised so much by the straight blocks, which makes it evident that her forefoot and heel must swim above an inch below the lower part of the keel under her main frame; which important defect must be allowed to increase, and the bad consequence attending it, in proportion to the hogging of the keel and main body of all ships, as have been so very often mentioned. A certain proof confirming that this vessel hogged, is, that when she came upon straight blocks in the Graving-Dock, her copper sheathing was visibly wrinkled at her forefoot and heel, and her mainmast then sunk an inch and half. Therefore to remedy further this defect of hogging, and that of shipping water in the open waist which is common to all open-decked frigates, deserves further notice and attention. All large, open, ^{Opendeep-} *deep waisted* frigates may be justly said not only to be weak ^{wasted} *in*

she hog, &c in that part, which tends greatly to make them hog, but also to be dangerous to a great degree when deeply loaded. On a voyage in 1738 to Madras and China, when our East India ships had open waists, not having water to go over the Flatts in turning to windward down the Swin, the common track for our deep loaded colliers, our vessel shipped so much water, that it took all the pumps to keep her free, so that when we got into the Downs, the crew protested against going the voyage without her being lightened, but, a 50 gun ship of war being near, a signal was made, and they came and took the principal ringleaders out, and we proceeded on the voyage.

I WOULD recommend therefore, in all large frigates, to allow breadth enough to build them with a flush-deck, what they now call three deckers, which has many great advantages attending it.

A Flush Deck attended with many advantages

1. This affords great and good accommodations for the crew, and makes it so easy for them to run quite fore and aft upon it, that they can work and manage the ship much easier and readier by it.
2. When deep loaded, it prevents those heavy waves of water being lodged upon deck, where the quick work is commonly leaky, as above mentioned, and thus may save a ship from foundering.
3. It fills up that weak and low part of the waist amidships, as may be observed in the frigates waist, plate I. figure 1, and the flush-deck going over it, strengthens the whole frame of the ship, so that, like a string to a bow, it helps greatly to prevent the ship's hogging ; and to do this more effectually I would recommend the present practice of building our East Indiamen in London, which I reckon are the best and completest merchant's ships in the world. They put a good chock lengthways upon the upper part of the keel between every floor timber within an inch of their height, and clip all the floor timbers, with the kelson as they term it. And with the curve downward as recommended will certainly add great strength to a ship's bottom.

THIS bad property of the Ship HALL shipping water at her gangways, was cured by laying a spar deck upon her, though left room to stow a large long boat on the main deck, which made her answer so well for that trade, that the same Ownery, built another ship upon the same principles with a flush-deck fore and aft, with a pretty long quarter deck above ; for the cabin and steerage in a plain manner for the same trade, but without the ornaments of carved works for a figure head and quarter galleries, &c.

&c. but only a knee head for the support of the bowsprit, and called her the *ELIZABETH*.

I think it necessary to remark here, that in building this ship, that my rule to form the bottom and keel with a convex curve downward in her length was strictly adhered to, (as recommended for the building the ship *HALL*.) And it gave me great pleasure, that after her first voyage they put her in the Graving-Dock upon straight blocks, to look at her bottom where I observed she retained what I call the necessary curve of her bottom and keel unaltered, that when she came adry, they put what may be called thin wedges under her keel, fore and aft, to support the curve whilst in the Dock, as she retained it, though they had stowed both her steerage and cabin full of Sugar and Rum, which I thought would have altered this curve of her bottom, which I reckon contributes greatly to give ships the most important good properties, adding to their strength, stowing, sailing, steering, staying, and wearing. Therefore I think no pains or expence should be spared to try the best rules that are the most likely to make the safest, dry, wholesomest, and most profitable ships for sea service.

NOT finding sufficient room to represent my ideas for rules to form merchant's ships hulls from that drawn by my friend Thomas Mitchel, Eq^r. at the top of plate the first. I got Mr. Elliot, to draw the final Drafts of the Ship *HALL*, as particularly described page 38, and put at the bottom of plate the first. But those ships designed for three deck frigates, will require either her main deck laid lower, or some more breadth to answer carrying guns.

THE very hard trials these two ships have met with, and the very extraordinary manner they have bore them, fully confirms me of the very great benefit and advantage their curved bottoms in their length has been to them. Therefore no pains or expence should be spared to give this form a fair trial, for I am thoroughly convinced that it contributes very greatly to preserve them from damage, both a ground and a float.

THE Ship *ELIZABETH*, happened to meet with a great misfortune full loaded with rum and sugar from Jamaica, in coming into our docks with a falling tide, grounded upon a narrow shoal ridge, with her midship and main body obliquely upon it, when deeper water at both ends, she heeled off toward the main deep on her beam ends, and laid a long time quite a dry, straining so much

On fixing a Ship's Form-Gage to regulate her Stowage by.

that they was obliged to nail hides over the weather side of her bottom, and had very hard work to get her floated to the quay to discharge her, and in the repairing dock found a great many of her futtocks and one flooring broke, yet the curved part of her main body retained its curve, though both ends had straightened so that the keel lay fair upon straight blocks. And I reckon if she had been built with a straight floor upon straight blocks as the common practice is, her back would have been broke so as to increase greatly the expence of her repairs.

THE Ship HALL, this last time at Jamaica, in order to increase her freight home, after stowing her hold and middle deck full of sugar and rum, stowed her main deck full from the fore part of the steerage to the fore part of the fore hatch-way, which consequently lying so high above water raised the center of gravity, and made her both deeper and cranker than she ought to have been, and in great danger of sagging the curved part of her main body downward to open the buts as often before mentioned to make her leaky, but I reckon that the pressure of the water upward against it, not only kept her tight but bore this extraordinary weight, that when she was discharged, they found had broke all the hold stanchions from the after part of the main hatch-way, to the fore part of the fore hatch-way; and two of the hold beams of the lower deck that was reckoned to be settled near six inches in the middle, and all the stanchions and two of the beams of the main or middle deck broke, &c. which seems to have occurred to those two ships; to confirm, and prove the strength of the principle of these curved bottoms, and the advantages attending them both a ground and a float.

On fixing a Ship's Form-Gage to regulate her stowage by.

ALL ships of any consequence are built with stanchions fixed from the kelson to the middle of all the lower deck beams fore and aft, in order to support them in their exact regular height, as well as the whole frame of the ship in the regular form in which she was built upon the stocks. Yet, notwithstanding these stanchions, the important and destructive facts which have been related, prove from experience, that our ship's bottoms hitherto, by the pressure of water and improper stowage, have generally been

been hogged upwards, or sagged downwards, and most about the midship frame or main body of the ship, which is commonly about the fore part of the main hatch-way, which naturally makes it the only and best place to fix the ship's Form-Gage, where either the hogging, or sagging of her bottom may be observed and seen soonest and best, to regulate the stowage of heavy materials to the greatest advantage, so as to keep her bottom nearly in the same form in which she was built.

THEREFORE, to fix the Form-Gage to the best advantage, I would recommend the stanchions under the lower deck beam at the fore part of the main hatch-way to be fixed a little shorter than the rest, so as to have about a quarter of an inch play at the tenon, or, as it is called, the tennant, at the top; and the Gage to be nailed, or screwed fast, to the top of the after side of the stanchion, made of a piece of flat iron about half an inch broad, and a quarter thick, and bent so that it may rise and fall with the ship's bottom and stanchion freely, up or down, in a small groove made for it perpendicular in the after part of the beam to about half an inch above the upper end of the Gage, to save it from being hurt by any thing going up or down the hatch-way; and this after part of the Gage to be graduated, and marked, with a file or cold chissel into inches, halves, quarters and eighths of inches, like a carpenter's rule, for a standard mark o. i. ii. iii. iiiii. inches upwards to the top of the Gage, and one inch downwards below the standard mark, and a small thin plate of iron, suppose three inches long, and half an inch broad, let it fair with the beam, and screwed to it with what is called wood screws, right across with the upper edge, exactly even with the standard mark of the Form-Gage when the ship is upon the stocks; and when she is launched, I do not in the least doubt but that the upward pressure of the water will act upon the bottom instantly, and cause the standard mark of the Form-Gage to rise above the cross plate, and thus point out plainly the quantity of ballast or materials which is required to be flowed in the bottom of the main body of the ship to counter-act this upward pressure, and to bring the Gage and bottom to its standard form place, to prevent the tendency to hog the bottom; which is necessary even though a ship is designed to be laid by for a time.

So that it appears to me that if this cheap, easy, simple method, was fairly tried and duly attended to, as the standard mark of the Gage rises and falls with the prevailing pressure, either to hog or sag

sag the ship's bottom, it would certainly be a guide to point out how ballast, heavy cargoes, or materials ought to be trimmed, or stowed, more or less fore and aft, higher or lower amidships in the main body of the ship; as will be more particularly recommended hereafter, when treating of stowing and trimming of ships to the greatest possible advantage for safety and sailing.

AND thus by the help of this Form-Gage, we may hope, not only to avoid such destructive and fatal consequences as often attend bad stowage; but to answer the important purpose by good stowage, to keep ships' bottoms nearly in the form in which they were built, as has been observed, which besides all other advantages above mentioned, will contribute greatly to make them wear much longer, strong and tight ships. And the HALL breaking the stantions on her middle deck, shows a Form-Gage is wanting on the top of that stantion as above mentioned.

On H A U S E - H O L E S.

THE many disadvantages I have seen to attend hause-holes being too small, makes me think it requisite to mention here, that it is absolutely necessary that all hause-holes should be made big enough at first; to admit the ship's cables, when spliced with a short splice, to go freely through them.

On fixing the R U D D E R.

AS the management of all sailing vessels, may be said to depend entirely upon the rudder, to steer, stay, and ware them, therefore the utmost attention is required to have it fixed by the best rules which have been found from experience to make it answer its important purposes to the greatest possible advantage, and not at random as ships and vessels may happen to differ in their breadth abaft, or have more or less room for the helm to be put over to make the rudder to traverse to a greater or less angle from the direction of the keel, by which principle it acts to manage the ship as occasion may require. Therefore here I think it necessary to remark, that the power of the helm to manage the ship depends more

more on her head-way through the water, than on any great angle it can be put to. For when a ship has no head-way, the greatest angle the helm can be put to has no effect upon her; nor when she gets head-way with the helm amidships, it does not act with any power, till it is put to an angle from the direction of the keel; then it is that the rudder begins to act, as what is commonly called a stop-water, but, more properly, may be called a stop-way, by the water acting against either side of the rudder that is put over, to turn the ship's stern the other way, in the direction of the tiller, to steer and direct her head, as occasion may require. And in proportion as the helm is put over from the direction of the keel, the rudder stops the ship's head way through the water, and it is well known that no vessel will stay that does not keep her head-way till she brings the wind right a head. Yet I have seen in boats, and vessels of 40 tons and upwards, where the rudder and tiller admitted of it, ignorant people put the helm almost right athwart the stern in stays, which tends more to stop the vessel's head-way through the water, than to bring her head round against the wind and waves from one tack to the other, thinking they cannot give the vessel too much helm in stays, and not considering that when the helm his put right athwart the stern at a right angle with the keel, the rudder then acts only to stop the vessel's way, without any power to turn the stern to steer her, which proves how necessary it is to have the rudder fixed by the best rules to prevent such bad practice.

ON enquiring what was thought to be the best angle for sailing vessel's rudders to be fixed to traverse to, I was told by my friend Mr. Henry Bird, (a great ship-builder at the Greenland Dock, London,) that 33 degrees, or 3 points of the compass, had been long the most approved practice. But many people argued that 45 degrees, or 4 points of the compass, would answer the purpose better, which made me try experiments with a well formed model of a ship in a cistern of water within doors, with her rudder fixed and marked to traverse to 4 points of the compass. She was pushed right forward with equal power in one line of direction through the water, first with the helm amidships, then altered to a point of the compass each trial to 4 points; but she made a less sweep and shortened her distance through the water each point the helm was put over, so that she went much farther with the helm amidships before she stopped, than with the helm fixed at 4 points. But to have it further confirmed that 33 degrees is a sufficient angle for

On fixing the R U D D E R.

for the rudder to traverse to, having the management of our three long Graving-Docks at Liverpool, where we have in common 10 or 12 ships at a time repairing and cleaning, I took the opportunity with a bevel to try the traverse of many ships rudders, Dutch as well as English, both full for burden, and sharp for sailing, and found none to traverse 33 degrees, but mostly about 30 degrees, and several about 28 degrees, and have often observed small vessels that had long tillers came over the top of their round-houfes which could not traverse above 20 degrees. From these remarks I think we may draw a conclusion, that 33 degrees is a sufficient angle for the rudder to traverse to, and ought to be fixed for the best rule. And the beveling of the fore part of the rudder and its bands should all be made to admit of that angle, which may give the utmost power to the helm to govern the ship to the greatest advantage on important occasions, because the safety of the whole often depends upon it.

THE rudder of the above mentioned ship, HALL, was tried and found fixed at this angle, with three inches of the main and three of the false keel, (six inches in all) going under the fore part of it, as before related.

THEREFORE, by what ever method a ship is designed to be steered, stops should be put to prevent thoughtless people, as abovementioned, from straining things to put the helm further over than 33 degrees, or 3 points of the compass. And as ships are sometimes lost, by losing their steerage in narrow channels, from having their rudders unshipped by striking upon the ground, I thought it fair to relate an instance we had at Liverpool of a ship being lost by the loss of her steerage, though her rudder was hung in the manner described in the first Edition, page 17, as practised at Parkgate, near Chester, with eyes in the bands of the rudder, as well as those on the sternpost, with a long iron bolt to go through them, which permitted the rudder to rise about 20 inches when striking upon the ground. This ship, coming into Liverpool too early of the tide, struck upon the Bar and beat over it, but got so much damage that she filled with water; the rudder, as expected, did rise in striking without unshipping, but bent the long iron bolt crooked into bights, so that it would not traverse to steer the ship on shore in the river, when she might have been saved, but she was drove above the town in deep water, and totally lost.

THIS

THIS instance, I think, is a sufficient proof that this Parkgate method of hanging the rudder did not answer the designed purpose, and that it is therefore best to continue the common practice to hang them with what I would call rudder-bands, whether made of iron or bras; with eye-bands upon the sterapost, and pointed bands upon the rudder, (a name more proper than that obscene one we commonly give them,) and to prevent the rudder as much as possible from unshipping by striking upon the ground. I would not only recommend it to be well wood locked, but also not to be made so long, and to go so low, as to be in the same line with the lower part of the keel, as customary; for it should be considered, that ships commonly swim by the stern, and that, in a rough sea, it is with the 'scending motion that they strike the ground at first, and the after part of the rudder, being lowest, must naturally in proportion be the first part that strikes hardest, which unships or breaks it. Therefore the fore part of the lower part of the rudder should go no lower than within 6 inches of the lower part of the keel, and the after part than within 8 or 10 inches; and the after part of the keel ought to project about 6 inches under the fore part of the rudder, and to be rounded at the after end: the having an iron strap just before this projecting part of the keel will strengthen it, and be a guard to prevent the rudder from being unshipped. This I have seen put in practice with a common sized rudder, and, by the commander's report, the ship steered very well, and kept ropes from getting into the heel.—I have observed a common practice in many ships, in order to mend their steerage, of making their rudders broader: instead of using a solid piece of light wood, they have two battens nailed on each side of the flat part of the back of the rudder, not considering that the extent of the flat of the after part of these battens, and the great vacuity between them, makes the ship tow a proportional quantity of eddied water after her, and the particles of water being known to have both attractive and cohesive properties that require force to part them, they must therefore naturally retard proportionally both the ships sailing and steering; and especially, when the helm is hard over either way, they must hinder her stern from turning in the direction of the rudder to turn her head as occasion may require. Therefore when ship requires her rudder to be made broader to mend her steerage, I would recommend to use a solid piece of light fir, which is much lighter than water, and the after part to be rounded to a half circle, as the back of all rudders ought to be, which admits

mits the particles of water to close on each side to the middle, washing the others off from the back of the rudder, which must help both the sailing and steering of a ship. And the cut-water should be rounded in the same manner.---To prevent the shoulders of the pointed bands upon the rudder from rubbing upon the eye bands upon the sternpost, which makes the helm traverie hard, instead of what I call a blind band upon the sternpost, I have seen put in practice a more simple method of only a half rounded piece of iron about eighth inches long, one and an half broad and thickest at the top, and one inch below, with two nail holes, the flat part to be let into the sternpost about half an inch, to stand perpendicular, for the upper pointed band on the rudder to rest upon the upper end of it, which will keep the shoulders from rubbing, equal to a blind band. And I cannot help thinking, that if there was a flat iron bar with holes to fasten it with nuts, wood screws, it formed to fit to the fore part of the projecting part of the keel, as mentioned for the ship HALL. And represented in plate the 12th, to form an idea of the make shift rudder. And I would further recommend that the lower pointed band of the complete rudder, might be fixed so low, that its point might turn as a pivot upon it in conjunction with the upper band as above mentioned, and I would have it formed to be let in even with the wood, and to reach four or five feet forward under the false keel to preserve it from being beat off. And this lower band of the rudder so much lower than common, will greatly strengthen its bottom from being hurt by striking aft.

On MASTS and YARDS.

I PROFESS myself an advocate for as stout lower masts as can be well supported on end, and short yards, from the example of ships in the coal and timber trades to London, and from the experience I have had of ships sailing faster upon a wind from shortening their yards, which must eat them by making every thing lighter, in proportion as the yards are shorter. Even the expence is less at first fitting out, and to the ship and every thing aloft in wear and tear afterwards, and in sailing her with fewer hands.

ALL masts which are to be made from crooked poles, should be made and fitted to stand with the back aft, that is with the projecting

jecting or crooked ends forward, which will make them stand upright without that great stress upon the stays, which must act against all the other rigging, to prevent the masts' heads from raking too much aft, which is most commonly the case. And when lower masts are obliged to be made from square balks which are not thick enough to make them proportionally round, to take only a little of the four corners off is sufficient for the lower mast, where necessity requires to make the most strength from a single balk.

THE method we now practice of having few blocks, and little tophamper aloft, for ease and neatness, is certainly right, and should be pursued as far as it can be with safety; but I would advise, not to carry this fashion to an extreme, by having too many shave holes cut in the masts' heads, for I have known many top-masts break in the place of the shave holes, under the rigging.

A TOPGALLANTMAST going up and down abaft the topmasts, as I have found from experience, answers many good purposes in a cruising ship, and is a great advantage to a ship that must often turn to windward, as they may be struck, and kept close struck occasionally, with the whole topsails trip, as represented plate the 2d. figure 1.

On SHIPS' SAILS.

THE square sails, suitable to taunt masts and short yards, as here recommended, will be in proportion, deep and narrow, which will trim and stand much fairer upon a wind, than if they were shallow and broader; and, if the ship's employ require it, will admit of larger stayfairs; such stayfairs as are now made with judgment, not to hoist too high at the back of the square sails, to shake the wind out of them, but which permit all the sails to stand to great advantage, clear of each other, as may be seen in the front plate, where the ship is represented in a light breeze sailing close by the wind.

To endeavour to make a ship sail by the wind, and turn well to windward, deserves the greatest regard, because safety, as well as many other great benefits, depend upon it. The good effects of deep narrow square sails recommended in the coal and timber trades to London, though the designed properties

Narrow

deep

square

sails re-

commend

ed.

in building and fitting these ships, are burden at a small draft of water, to take and bear the ground well, and to sail with few hands, and little ballast; yet these ships perform so well at sea, that government often makes choice of them for shore ships, in the most distant naval expeditions; and in narrow channels among shoals, and in turning to windward in narrow rivers, there are no ships of equal burden can match them, which I attribute a great deal, to their deep narrow squaresails, which may be preceived to trim so flat and fair, upon a wind, that all the canvalls stands full, at a proper angle from the direction of the keel, so that the wind goes freely off from the lee leech of these sails, without being much altered in its direction from one sail to the back of the next, which is not the case, when a ship's squaresails are so broad as to overlap each other much, one sail then shakes the next to it, and they extend so far to leeward, that the lee sheets make the after part of the canvalls, or lee leeches, stand rather as so much back sail to stop the ship's way, or only to press the ship's side down and to leeward, which is the effect of all the canvalls in a ship's sails, when it does not stand at a proper angle with the direction of the keel, when a ship is sailing close by the wind. Where a deal of canvall is wanted, to sail fast large, the narrow deep squaresails have in height, what they want in breadth; and the flying sails, including the topgallantsails as such, being all of lighter canvalls, may be made as large as things will admit of, to answer this purpose in little winds; and when it comes to blow so strong, that these flying sails cannot be carried, then the standing squaresails will be found broad enough.

I HAD the yards of a frigate-built ship shortened so much, and the mainsail made in proportion so narrow, that the maintack was hauled down through iron-bound blocks which hooked to eye-bolts within board, fixed for that purpose, and which made the sail to stand much better, and work much easier than when at the chestree without board.

Foretacks
to stand as
fartoward
ward as
mantacks

THE foretacks of all ships should be made to stand by bumkins, or at the cat-heads, &c. as far to windward as the mantacks, by which I have experienced, the forefais will stand as near or nearer the wind, than the mainsail will when trimmed at the same angle. For the same reasons, a collier's foretopsail stands upon a wind without a bowline, as the wind acts upon the head sails, without being turned more aft from one sail to the other abaft it.

I HAVE

I HAVE taken the angles the principal sails stand at, from the direction of the keel, on board of a ship, and of a sloop, as they have been turning to windward with a pleasant breeze; the ship's mainsail and foreail, with their topsails and topgallant sails above them trimmed, and stood at three points of the compass, which was at just half the angle the ship stemm'd from the direction of the wind, which was at six points upon each tack, but the cross-jackyard at the same time required to be braced up to two points, and the mizentopsailyard to a point and a half, so that the plain or body of the mizentopsail stood at a point and three quarters, or 19 degrees; the mizen stood at about a point and a half or 17 degrees, and the staysails between the masts stood at about the same angle, 17 degrees, when drawing full, and by the wind. The sloop stemm'd at five points of the compass from the direction of the wind, when her mainsail, foreail, and jib stood at about half that angle, or two points and a half from the direction of the keel upon each tack.

The angle
ships stand
at when
turning to
windward

In ships designed to carry many small sails in little winds, I have had the experience of turning to windward with 30 effectual sails, set in a simple easy manner, and had them drawn, when in real practice at sea, and they were as represented in the front plate. Besides two jibs, foretopmaststaysail, spritail and spritsailtopsail, which are known to stand very well upon a wind, we had a fore-staysail stood very well by our foremast standing well aft, and the fore-tack well to windward, as before recommended; and by having two sheaves in each truck, at our long topgallant masts' heads, we hoisted the topgallant royals up to the trucks by the sheaves on one side, and the main and mizen spindle staysails by the sheaves on the other side of the trucks, at the main and mizen topgallant-masts heads, we set a gaff topsail with a light yard slung by the thirds, hoisted up through a block at the after part of the cap at the mizentopmasthead, the tack hauled down on the weather side, to the after corners of the mizen top, and the sheet to the gaff end. This sail was easier managed, and stood more to advantage, than when set with a cumbersome heavy gaff, rigged at the mizentop-mast head for that purpose. We set a large driver with a light pole for a boom, with two tail blocks at the small, or outer end, which we run out aft on either side, and lashed it to the rail, so that the blocks on the outer end stood right aft, facing the middle of the stern, upon either tack, the driver slung by the third of the yard, like a lug-sail, hoisted within about four feet of the end of the

Setting
many sails
in an easy
manner.

the mizen gaff, which was about three feet longer than the mizen required it, on account of this sail: the tack hauled down to the weather quarter piece on either tack, and the sheet to the block amidships, with a bowline hauled to the mizen mast, which made the sail stand fair upon a wind, at an angle of about a point and an half, or 16 degrees from the direction of the keel; we set a fore-topmast studding-sail for a water-sail, the yard flung by the third, hauled out to the other tail block at the driver boom end, with the straight leech or the sheet clue uppermost, and made fast to the weather corner of the stern rail, and the lower clue had two sheets or lines led into the aftermost gunport or scupper in the waist on each side, so that in tacking when the wind was near ahead, we shifted the fore part of these sails to the weather side, which trimmed them ready for the other tack, by which means they prevented the ship from falling too much off, and had good effect upon her sailing in a light breeze of wind. But when it came to blow fresh, the wind, reflected from the mizen, shook the driver so much that we took it in when sailing close by the wind, and when we rigged in the boom, it lay snug fore and aft on one side, stopp'd to the rail, and was much more out of the way than a cumbersome heavy yard, which is often used for a driver boom, and which, lying across, is inconvenient, and holds wind when the ship is sailing close hauled, and can only serve to set the sail to advantage, when sailing with the wind quartering, or before it. But I must own the late improvement of the long boom mizen, greatly surpasses the driver sailing upon a wind.

On sailing large with many sails. In sailing any thing from the wind, to right before it, we easily shifted our driver boom to different parts of the stern, and by the heel ropes at the heaviest end within board, trimmed it as the wind required, so as to make the driver and water-sail stand as fair and as far, or farther, out from the ship, as could be done by a yard across for a boom, as abovementioned. We set topgallant studding sails, without troublesome and cumbersome booms on the topsail yards, by having thimbles fixed at the outer end of the topmast studding-sail yards, we kept the tacks reeved and both ends made fast to the inner yard-arm, so that they could be come at from the topsail yard-arm to bend the tack and haul it out, which spread the sails and made them stand very well, and shewed with the driver and water-sail as in plate the 1st, where the ship is represented sailing with all sails set, with the wind quartering. But I must own we were obliged to stop the inner yard-arm of the topmast studding

studding sail, with the outer gaffet of the top-sail yard-arm, when the sail was set abaft the top-sail, to prevent the outer yard-arm from flying forward.

It is said that we have ships that will bear and carry sail so as to get to windward, or keep clear of a lee-shore, as long as canvas will stand. In such a case safety must often depend upon the sails, therefore the method of making them should have all the strength that can be given to prevent their splitting in times of danger.

It would contribute greatly to make canvas stand a storm, and wear much longer, if the sails were made with robands, grommet, and point holes, in the middle of every seam, and about half an inch lower down in the sail than those holes that are found necessary to be between the seams, and which fall in the single part of the canvas. By this method the greatest strain will be upon the seams, which are the strongest parts of a sail, and will bear a greater stress than they will by the present practise of making all the above holes in the single part of the canvas, clear of the seams, which is done to avoid as I suppose, cutting and sewing through so many folds of canvas; for there is now made about the same quantity of holes as I would wish to recommend here, that is, a hole in each seam and one midway between, which is enough for any sail, and for the sail that reefs by the foot, a point hole in each seam is found sufficient.

I HAVE tried to manage the sails in a cruising vessel, and in cod-smacks when fishing, with robands and points in the seamed parts of the sails only, in order to reef and unreef them with more expedition, and lay the more stress where the principal strength of the sails lay, but found from experience that it requires robands and points in the middle part of each cloth, to confine the sails cleverly to the yards and gaffs; therefore the holes that are made in the single part of the canvas ought to be a little higher up in the sail, that the principal stress may be upon the seams which I reckon is about three times as strong as the single part of the canvas. When the sail is seam-pricked, as all the foul weather sails ought to be, in a zig-zag or serpentine manner, as soon as they are stretched a little by wear, if the sails are not confined to the yard, stays and gaffs, more by the seamed part of the sail than by the single canvas, the weight of the seams will contribute to split and wear out the single canvas much sooner, especially when the sails flap hard in gales of wind, or when obliged to carry sail in little wind with a great rolling sea.

Sails how
strengthened
in the
making.

INSTEAD

On RIGGING and ROPEs.

INSTEAD of cutting these holes through so many folds of canvas at random with a knife, I take the liberty to recommend to have a round hollow tool or gouge with a mallet, and a block upon the knees, for the purpose of cutting the holes more regular. But it is in this as in other proposed improvements. It is difficult to get people out of the common practice, and some tradesmen have such contracted notions, and not ashamed to say it, that the strength of work is the decay of trade. But in all things belonging to shipping encourages trade in general amongst us. And I would have all well paid for useful improvements.

On RIGGING and ROPEs.

WE should avoid all unnecessary rigging, as well as blocks, for every thing that the wind blows upon, about a ship, which does not stand in the place of direction with the sails, is a hindrance to the ship's failing upon a wind, therefore the running rigging should not go double, where single will answer the purpose. The close net-work with bobs, which I have seen hanging under the fore part of ships' tops is useless top hamper and crow feet there, and in my opinion, does more harm than good.

I WOULD advise to have all ropes above six inches round, to be cable (or double) laid, that is with nine strands, instead of three, with the same number of yarns; for reason as well as experience teaches us, that in all single or shroud-laid ropes with three strands only, and above six inches round, the out-side yarns in each strand are strained in making the rope hard enough, by being worm'd or twisted round at so great a distance from the centre, that the yarns about the middle of the strands are by that means made to be slack, so that before they come to bear a strain, the outside yarns must be broke. That this is a fact may be perceived when opening a strand of a large shroud-laid rope; one sees there the inside yarns are drawn up slack when the outside yarns are worn out and broke; for which reason I would recommend the standing rigging, above six inches, to be cable-laid, with the same quantity of yarns, which will be stronger than the shroud-laid rope, in proportion, as all the yarns lie in a straighter direction with the length of the rope, consequently, they all bear the more equally a part of the strain.

Ropes above six inches to be cable laid.

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I HAVE tried the strength of a number of threads together, made fast to a scale beam, 1st, laid in a straight direction, without any twist, like to a selvage; 2d, the same number moderately twisted; 3d, an equal quantity twisted more, and I found from repeated experiments, that those with the moderate twist, bore the greatest weight before they broke, and that a number of threads joined together will not bear a proportional weight to one of them singly, that is, ten threads comes a great way short of bearing ten times the weight that one thread bore singly, and hence I conclude, the case is the same with a rope and one of its yarns.

Hints for Supporting Ships Masts with Eye-bolt Chains, instead of Hemp-rope for the standing Rigging.

THE very great strain I have seen eye-bolts bear on board ships, makes me think that their masts may be supported by eye-bolt chains to great advantage, instead of rope which is now grown very dear in proportion to iron.

EXPERIMENTS might be easily tried to confirm or confute this opinion, by taking, suppose three fathoms of shroud rope, and make three fathoms of eye-bolt chain, made of such tough iron as the whale harpoons are made from the same weight as the rope, suppose the links of the chain to be two or three feet long, according to the size of the ship, the longer they are made, the lighter the shrouds and stays will be, bend them together and try with sufficient power, which stretches most and breaks first the rope or the chain.

If the chain gains the preference in lightness and strength without stretching, I would recommend an iron plate, suppose half an inch thick, or more according to the size of the ship, to be worked together so as to lie fair and flat, just broad enough to cover exactly the upper four square part of the threftle-trees that exactly fit the mast heads, with four holes to be bolted there, and long enough to be bent downwards on each side pointing to the dead eyes below, with holes big-enough that the upper link of each shroud may be hooked to and mouled, and one hole on each side above them at the fore parts of the plates for long links for the collars of the stays to be hooked to and mouled, as represented in plate 12th, drawn from a model which I got made, and rigged

her lower masts with wire links and thread lanyards, set up the shrowds and stays to their proper tightness, for the opinion of professional men, who allowed that ship's iron futtock plates would wear them out, and no doubt but a set of this standing rigging would do the same, if it was found from fair trial to answer its purpose. And as to preventer and stay-fall-stays they may be of rope and go under the stays as usual.

These hints I cannot help thinking deserve the consideration of professional gentlemen that have power in our incomparable Royal Navy, where such experiments should be first tried to bring them into use, for I reckon they would be proof against the fire of small shot, and if broke by large shot, having spare ones made for links, the damage might be soon repaired, and might be contrived to make them conductors of lighting from the mast heads into the water alongside.

If this hint ever meets with approbation powerful enough to give a fair trial, I would recommend to prevent the iron links from rusting, and feeling too cold in very cold weather for the hands going up and down the shrowds; to have the links well tarred and covered over with spunyarn, or sowed over with tanned horse-hide, &c.

ON STOWING AND TRIMMING A SHIP.

A SHIP's sailing, steering, staying and waring, and being lively and comparatively easy at sea in a storm, in my opinion, depends greatly on the cargo, ballast, or other materials being properly stowed according to their weight and bulk, and the proportional dimensions of the ship, which may be made too crank, or too stiff, to pass on the ocean with safety. These things render this branch of knowledge of such consequence, that rules for it ought to be endeavoured after, if, but to prevent, as much as possible, the danger of a ship oversetting at sea, or being so laboursome as to roll away her masts, &c. by being improperly stowed, which is often the case, which appears to me to be one of the most difficult and essential matters that concerns the management of ships, therefore deserves proper encouragement for learned men of science to endeavour, to account for from fixed principles, and to give reasons, why ships, or the same ship, may be thus differently affected by stowage,

so

So as to instruct seamen in this most important point of duty, because, success as well as safety, may greatly depend upon it; for it is known that our government has had two ships of war built by the same set of moulds, fitted in the same manner, and with the same materials, as near as possible, yet one ship answered much better than the other. This can only proceed from different management, which induces me, (sailor-like), not to halt before I find my self quite lamed, but to push forward, at all hazard, to endeavour to explain what I know, from experience and observation; which I hope will be found of some service, if it only induces others more capable, to consider and treat this most important subject, with that attention, and to that extent, it deserves.

WHEN a ship is new, it is prudent to consult the builder, who may be supposed best acquainted with the ship of his own planning, and most likely to judge what her properties will be, to advise how the cargo or materials, according to the nature of them, ought to be disposed of to advantage, so as to put her in the best sailing trim; but I would recommend trials at every favourable opportunity afterwards, to find out or to confirm which is the best trim of a ship for sailing; as experience is the only guide, when science does not point it out.

I WAS in a fine ship which did not sail to expectation, and the fault was always laid on her not being stowed to swim at her proposed trim, which was so much by the stern, that a full part coming into the water aft near her loaded mark, prevented her flowing the cargo so as to bring her to that designed trim, but when the experiment came to be tried, to swim her more upon an even keel, so as to keep the too full part more out of the water, the ship then sailed much better. I have been cruising in concert with a ship that we out-sailed every way, but by their taking their anchors from her bows and stowing them abaft the bits, it gave her such advantage that she out-sailed us after that, both by the wind and large. Being appointed from our Pilot's Committee with Mr. Bryan Blundell, Merchant, who had been a great and successful shallop-racer in the West Indies, to go with two of our Pilot sloops and Pilots to survey our neighbouring ports, to fix rules to examine our Pilots by; the floop we happened to be in was the worst sailor of the two: Mr. Blundell said he would make her sail better than the other without meddling with the mast, sails, or rigging, or trimming her more by the head or stern, which he did

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by getting the Pilots to move the heaviest loose materials from fore and aft into the main body amidships, which answered the designed purpose, and made her beat the other sloop as much as they beat us before. I was in a common merchant ship deep loaded with lime-stone amidships from Lisbon to the Western Islands, where we found her a match in sailing with one of our Lisbon Packets, which are built for sailing only; but we were very leaky at the same time, which, I reckon, was owing to her bottom being sagged downwards amidships by the weight of the stone lying there. And I was told of a master of a vessel that carried iron-ore, who used to say, "when we are loaded with iron-ore we beat every body, but when not loaded with iron-ore every thing beats us," which tends greatly to confirm the advantages of curved bottoms, as well as heavy materials stowed towards the main body, for sailing fast. But care must be taken not to sag down their bottoms too much to open their butts, as mentioned page 15.

What sort of ships require different management in the stowage, which ought not to be left to mere chance, or done at random, as goods or materials in flowing happen to come to hand, which is too often the cause that such improper stowage makes ships unfit for sea, therefore the stowage should be considered, planned, and contrived according to the properties of the ship, which, if they are not known, should be enquired after. If she is narrow and high-built in proportion, so that she will not shift herself without a great weight in the hold, it is a certain sign such a ship will require a great part of heavy goods, ballast, or materials laid low in the hold, to make her stiff enough to bear sufficient sail, without being in danger of over-setting. But if a ship be built broad and low, in proportion, so that she is stiff and will support herself without any weight in the hold, such a ship will require heavy goods, ballast, or materials stowed higher up, to prevent her from being too stiff, and laboursome at sea, so as to endanger her masts being rolled away, and the hull worked loose, and made leaky.

I SPEAK from experience, having been in ships of both extremes; some too crank, and others too stiff and laboursome at sea; and I have been in company with a ship so stowed, as to be so crank as proved fatal to her and her crew; which last is the most dangerous of the two extremes.

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THE facts I related from experience, page 30, shew that there must be a medium from the best proportioned breadth of a ship, according to her designed trade, and which should be endeavoured after, that she may be so stowed as to prove neither too crank nor too stiff, and which is such as to admit the ship to yield or hee to her sails, when the masts are in danger of being carried away by being overpressed: for that ship is sufficiently stiff for any purpose, that will bear to carry away her masts before she will overset. If this trim could be hit upon, by any rules for the construction and stowing of ships, it would be of great advantage to make them pass through the ocean with more ease, and consequently, less damage, for the over-stiff ship, when pressed hard with sail, strains every thing imperceptibly to a dangerous degree, and to guard against her masts being carried away, obliges to keep a constant looking up, to see how much they bend, which cannot be so much attended to, as when the ship heels in proportion as she is over-pressed, which gives the surest warning to take in the sail in proper time.

IN order to help a ship's sailing, that she should be lively and easy in her pitching, and 'seending motions, it should be contrived by the stowage, that the principal and weightiest part of the cargo, or materials, should lie as near the main body of the ship, and as far from the extreme ends, fore and aft, as things will admit of. For it should be considered, that the roomy part of our ships, length-ways, forms a sweep or curve, near four times as long as they are broad, therefore, those roomy parts at, and above the water's edge, which are made by a full harping, and a broad transom to support the ship steady, and keep her from plunging into the sea, and also by the entrance and the run of the ship, having little or no bearing body under, for the pressure of the water to support them, of course, should not be stowed with heavy goods or materials, but all the necessary vacancies, broken stowage, or light goods, should be at these extreme ends fore and aft; and in proportion, as they are kept lighter by the stowage, the ship will be more lively to fall and rise easy in great seas, and this will contribute greatly to her working, and sailing, and to preserve her from straining and hogging, for which reason I think it a wrong practice to leave such a large vacancy in the main hatchway, as is usual to coil and work the cables, which ought to be in the fore or after hatch-way, that the principal weight may be more easily stowed in the main body of the ship, above the flattest and lowest floorings,

floorings, where the pressure of the water acts the more to support it, as mentioned page 10, on the pressure of water.

On the Centre of Cavity, Gravity, and Motion of a Ship.

TH E S E are fundamental points which certainly exist in a ship; and her trim, as last mentioned, depends upon their places, but so little are they understood, as I have been told, that a great sea officer was heard to say, when his ship was labouring hard in a rough sea, how should she but roll when she had so much top hamper? which was ascribing the effect to a wrong cause, and is what will be often the case till the fundamental principles are known; I am therefore emboldened to endeavour to communicate what I have learned of these difficult points, hoping an abler pen, will some time undertake to amend and make up my defects, in the knowledge of these points, so that they may become useful to seamanship.

THE centre of cavity of a ship, is a point in the middle of the hold, or hollow part of the hull, which supports her loading and her materials, but it is in reality the cavity, or the centre of the bearing part of the ships' body, that is immersed in the water, that acts to support her in all the different situations, and motions a ship is subject to, which occasions this centre of the cavity immersed, to be always shifting its place; as the different parts of the ship's hull happen to be in the water, it moves from being about the midship, when the ship swims upright and upon an even keel, to forward or aft, as the ship is trimm'd more by the head or stern, and from one side to the other, in proportion as the ship is made to heel.

THE centre of gravity of a ship, is a place some where in her, where the weight of the whole ship, cargo and materials, in and about her is brought to a point: when the ship swims upright and upon an even keel, it is some where in a middle line of direction from the stem to the sternpost, where another line would cross it about the midship frame, from one side to the other, and if the ship could be suspended in air on this point, she would remain there in whatever position she was put into,

BUT the centre of gravity of a ship, is always liable to alter its place, higher or lower, more forward or aft, on one side or the other,

ether, according to the stress or weight that happens to be laid upon the different parts of the ship or her materials, not only by the management of the stowage, but by the power and pressure of the waves and wind.

THE centre of gravity of a ship, as in other heavy bodies, has always a tendency to descend to wards the center of our globe, whether the ship is on shore or afloat, if it is not prevented from falling by the base or bottom, that spreads without this point to support it. For whenever it happens that a ship is laid on shore, and heels so much that the centre of gravity over hangs that part of the ship's bilge, upon the ground, that ought to support it, the ship will be sure to tumble over, if not prevented by some means. And when a ship is afloat, if ever she heels so much, that the centre of gravity goes farther over to one side than the centre of cavity, or the middle of the bearing part of the ship's body then immersed in the water, the ship will overset; but whilst the centre of cavity immersed, goes faster and farther over to the ship's side, in her motions, so as to keep without the perpendicular of the centre of gravity, the ship will be supported from oversetting, and the water will act upon the centre of cavity immersed, in proportion to its distance without the centre of gravity, with more or less power, to bring the ship upright again, as soon as the force of the wind or waves ceases, or the power or weight is taken off or shifted, that occasioned the ship to heel or turn on one side. And it is well known from the experience of heaving ships down, that according to their proportional dimensions they require different management; those built low and broad requiring so great power as to endanger the mast, (*which is the lever, and on which the great strain lies,*) owing to the centre of cavity immersed, (*which is the prop* that the vessel turns upon on this occasion,) lying so far without the centre of gravity; and this it is which causes so great a strain on all the materials used to raise the centre of gravity, to heave the keel out: and if built high and narrow, by reason of the centre of gravity soon overhanging the centre of cavity immersed, a ship requires relieving tackles to be fixed to, as to ease her down, and prevent her oversetting, and to raise her upright again: so that the position of the centre of cavity with respect to the centre of gravity, is what regulates all the motions of ships, when afloat.

THE centre of motion of a ship, depends upon the places of the centre of cavity and gravity, as last mentioned, and as they alter,

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On the alter, the centre of motion shifts its place, but in ships, as in other heavy bodies in motion, this point always endeavours to be at the same place with the centre of gravity, and it is really so, when the centre of gravity is above the surface of the water, and the ship is afloat; but when the centre of gravity is below the surface of the water, and the water smooth, then the centre of motion is at the water's edge, which I found by experiments which I made with models of ships, about three feet long, in a trough of water.

Experiments on models of ships to find out their centre of motion.

I FIRST tried a model that was made exact from a draft well designed for a fast sailing ship, with a rounding bottom, as has been recommended; it was quite light, and had only a mainmast in, to heel her by, she swam upright, and drew three inches water aft, and two forward; I then stuck pins in, at the water's edge, in the middle of the stem and sternpost, then heel'd her gunnels in, by the mainmast head, which caused the pins in the stem and sternpost to rise out of the water, and form the sweep upwards, and made it evident the centre of motion was higher up: then I tried where her centre of gravity was, by suspending her in air, between two pointed irons, in the middle of the stem and sternpost, and found it about an inch and an half above the pins, at the water's edge, and found the points of suspension on each side, about the same height above water amidships: I stuck pins in these four points, pointing to the centre of gravity in the hold, and I found by repeated trials, that these upper pins or points, were the axis or the centre of motion that the turn'd upon; when making her heel and roll, those upper pins in the stem and sternpost had little or no motion, whilst those pins at the water's edge, rose out of the water as she moved from side to side; and when she was made to pitch and 'scend, by pressing her down fore and aft, those pins on each side amidships, seemed to have little or no motion, whilst I confined them as steady as possible to a point.

I LOADED the same model with lead, till she drew four inches and a quarter water fore and aft, and there stuck in pins at the water's edge, in the stem and sternpost, and found the centre of gravity, two inches and a quarter below these pins; then heeling her in the water, gunnel in, each way as before, I found the pins in the stem and sternpost, to continue at the surface of the water. I raised the lead higher up in the hold, till I found the centre of gravity at the water's edge, then heeling her in the water as before, found the centre of motion at the same place. I raised the lead still

still higher, till the centre of gravity was about half an inch above the pins, at the water's edge, then the model would just bear herself from oversetting. In this trial the centre of motion was at the same place with the centre of gravity, about half an inch above the surface of the water.

I TRIED a model of a high full built ship, that was rigged, and had guns upon deck, so that she would just support herself from oversetting, she drew five inches water forward, and six inches and a half aft. I stuck pins in the middle of the stem and sternpost at the water's edge as before, and found the centre of gravity fore and aft, an inch and a half above these pins at the water's edge. I there put in pins, and tried by heeling her in water as above, and found at these upper pins was the centre of motion, or axis that she turned upon, which will always be the case, when the centre of gravity is above the surface of the water. An instance of a ship launched, agreed with and confirmed the above experiments.

A MERCHANT ship built with a high and ornamented top, upon a sharp bottom, having her lower masts in, and rigged when she was launched, and, as is common at such times, having a great many people upon deck, all these raised the centre of gravity so high, and the centre of cavity immersed lay so low in her sharp bottom, when she came into the water, that it would not support her upright, but she fellied and laid down on one side, with the black stroke above the bends amidships in the water, this frightened the people upon deck, and all getting upon the upper side, she then fellied and rolled over as low the other way, and the people as before shifted themselves to the contrary side, which made her keep constantly thus sallying, whilst they towed her with boats about half a mile, and got to one of our dock quays, where the people gladly got out of her.

SHE was launched without her rudder, and I had the opportunity of standing near her, and observed a boat under her stern that was held by a man with the boats stem close to a rudder-band, about three feet above the water's edge, which rudder-band I perceived to have little or no motion, but was the axis of the centre of gravity, and motion, that she turned upon, while she was sallying or rolling, with her upper works in the water, which I reckoned was as high above the water, as the keel was under water amidships, when the ship was upright.

The center of motion shewn by the launching of a ship.

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CAUSES

CAUSES and effects are best discovered from experience and observation, and from these we must find out true principles. This ship's sharp bottom in the water, when she was upright, made too small a base, and the centre of cavity lay too low to support her upright, with the centre of gravity lying so high above water, that it made her fall or lie down on one side, till that brought a broader base into the water, and the centre of cavity (then immersed) was higher up, and farther over, and without the centre of gravity, so that the centre of cavity then immersed, became as a prop, to support the ship from going lower, as she fellied each way, and in this case, the centre of cavity was the centre of motion, that she turned upon, when her side was laid down; for all the weight and power that was without the centre of cavity acted as a lever, the same as when ships are hove down keel out, which lifted the centre of gravity a little, as she fellied, which soon preponderated again, and the people always moving over to the upper side, accounts for this ship's falling in this manner.

The center of gravity and motion are at the same place in great seas, and a ship's behaviour depends upon that place.

This ship's behaviour, and the above experiments, in my opinion, make it evident, that the centre of motion of a ship, is at the centre of gravity, and according to the form and proportional dimensions of the ship, and her centre of gravity being higher up or lower down, the different properties or behaviour of ships may be accounted for. From the construction of the above ship, when loaded with refined salt, that just filled her, the centre of gravity being then at a great height, the report of her performance at sea was that she answered very well, and was remarkably easy in her rolling motion, in great seas, though the spectators, at her launching, expressed themselves, that they would be loath to go in her to sea, on account of her rolling.

Heavy bodies turn in swift motion upon their centre of gravity and lying, their heaviest end foremost.

It is a known property of all heavy bodies, forced into quick motion through air, or water, that they turn upon their centre of gravity as their centre of motion. I have seen a bomb shell turn round in the air, by the centre of gravity being near the middle: and where the centre of gravity lies near one end, that heaviest end will go foremost in all directions, upwards, as well as downwards, as may be seen in skyrockets, and arrows shot from bows; an arrow shot with the light end upwards, immediately turns upon its centre of gravity for its centre of motion. The same causes produce the same effects upon ships, when by high mountainous steep waves they are tossed up and down, with a violent quick motion.

It must be allowed that there is a point in a ship which may be called the centre of motion, and which she turns upon, consequently

sequently it has less motion than any other part of the ship, when rolling, pitching, 'scending, or in any other motion a ship is subject to, in great seas, when its place is then at the centre of gravity, which lying higher, or lower, according to the form and dimentions of the ship, contributes to make her comparatively easy, or uneasy and very laboursome, in high waves.

SUPPOSE that in a well proportioned ship for carrying cargoes in general, when loaded, the centre of gravity and motion were even with the surface of the water, this would make her remarkably easy in her rolling in great seas. And again, suppose the said ship without dennage, to be loaded with lead, which is eleven times heavier than its bulk of water; in a smooth sea, this might seem a benefit by making her extraordinary stiff upon a wind, and what little she was made to heel to her sail, would turn upon the centre of motion at the water's edge, but if she should meet with great seas, so that she must rise and fall, in proportion to the height and quickness of the waves, that would give liberty for the centre of motion to act with its natural tendency to the centre of gravity, which by this stowage would be laid so low that the ship would roll away her masts, and be in danger of foundering, by working her hull to pieces.

FOR a further confirmation of the above opinion, I examined into the properties of a collier cat, of about five hundred tons burden, that carried her loading of Riga timber, without any ballast in the hold, who had about a ninth part of her cargo upon deck and on the quarters, and was sufficiently stiff, and remarkably easy in her rolling, in great seas, compared to what she was, when loaden with Newcastle coal, though she carried herself full of them, yet she was then remarkably laboursome in her rolling. And this difference may be accounted for, from the above principles, for when this ship was loaded with Riga timber, which is lighter than its bulk of water, it was computed, that about a third part of her cargo lay above the water's edge, at her loaded mark, which would bring the centre of gravity and motion as high as the surface of the water, when she drew about sixteen feet amidships; from thence to the upper part of the rigging at the main-top-gallant-mast-head, measured 108 feet, which is some what less than seven eighth parts of the whole, above water; and above the centre of motion; and is more than one eighth part under water, and below the centre of motion. And what made her sufficiently stiff, was, her extraordinary breadth, and the tight free board, or

upper works, above the loaded mark, that supported the centre of gravity so high, and that occasioned her to be so remarkably easy in her rolling, as the water and the waves acted at the least distance, and with the least power possible, above the centre of motion, on that small part of her hull above her loaded mark, to move, and give any degree of violent rolling motion, to so large a part of her body, that was under water, and below the centre of gravity and motion; for what her keel was made to move side ways, her top-gallant-mast-head had a little less than seven times more to move in the same time, therefore her rolling motion must be much less, and easier in great seas, than it would be, if she was loaded with coal, which is heavier than its bulk of water, and would make the centre of gravity and motion lie so much lower down in the hold, suppose four feet below her loaded mark when she drew sixteen feet water. In this case, the water is perpetually acting with an additional power, on that four feet of the cavity of the ships hull, that is immersed above the centre of gravity, to support the ship, and make her so much stiffer, to carry more sail upon a wind with an upright side, in smooth water, as before mentioned. And the same cause will make her more laboursome in great seas, when she comes to be lifted up, with a swift motion, from the bottom to the top of a high steep mountainous wave, that may break in upon deck at the same time, as represented, plate the 6th, on ships lying to. The ascending side of the waves in this case acts, with an additional power, to turn the ship bodily more on her lee side, in proportion as the center of gravity and motion lie lower, than when loaded with timber, and at the same time like other heavy bodies in motion upwards, she has a great tendency to turn her bottom more up, as the centre of gravity lies lower, as mentioned page 67. And in proportion, as these combin'd causes have turn'd the ships weather side up, at the top of the wave, which then leaves the weather side, with more of the bottom lower down, without water to support it, which must naturally fall on the defending side of the wave, they now act on the lee side of the ship, to turn and plunge the weather side deep into the hollow of the next wave, which will act as before, to give the ship more violent rolling motions, according to her breadth, and the height the waves have to act upon the ship's hull, above the centre of gravity, and motion, which now lies a little less than a tenth part, from the keel to the top-gallant-mast-head, so that for every foot her keel is made to move by the above powers,

The difference of being loaded with timber and coal.

powers, sideways, the mast head has nine feet to move, in the same time, instead of seven with a flower motion, which was the case when she was loaded with timber, and this I hope will be understood to account for the difference, why she is more laboursome when loaded with coals than with timber. And suppose this ship was to be loaded to the same draft of water, without any dunnage in the bottom with lead, which is eleven times heavier than its bulk of water, which might bring the centre of gravity The consequence
of load-
ing lead
without
dunnage. and motion eighth feet below the water's edge, and within eighth feet of the lower part of the keel, which is less than a fifteenth part from the keel to the top-gallant-mast-head, in such a trim it is well known from experience, that in a storm, the above mentioned causes would act with so much more power, to give her more quick, violent moving, rolling motion, and for every foot her keel was made to move sideways, the mast head would have to move fourteen feet in the same time, which would be sure to make her roll away her masts, in the first place, and after that, become so much more laboursome, for want of them, as to be in great danger of foundering, by working loose the hull.

I HOPE what has been said on this important subject, makes the principles understood, how ships act, and how they are acted upon, by those natural causes above mentioned, and the necessity there is to try every expedient, that may prevent the loss and damage occasioned by the ships being too crank or too stiff; for I am convinced from experience and observation, that it is not the shape of the ship's bottom, that makes her easy or uneasy in her rolling motion, as is commonly believed, but it is the centre of gravity lying higher or lower, according to the breadth and height of the vessel, the water acts with more or less power; and that makes narrow built ships fittest to carry heavy cargoes, with the least expense of dunnage, whereas for light bulky cargoes, broad ships will answer best. The above mentioned ship was much easier in her rolling motion, when loaded with timber, than with coals, which was a certain sign that her deck lay too low, for her breadth, to carry that cargo with ease in great seas; and by account, she was stiff enough when quite light, to bear sail to go any where, and only took in ballast, to make her sail better by the wind, so that it is evident, that this, as well as every other ship, has a certain trim, which to them, is the safest, easiest, and best. And when this best trim for stiffness is observed, from experience, hints proposed to try experiments, to get and keep them afterwards

Experi-
ments re-
commend
ed to keep
ships in
their best
trim, by
their dif-
ferent de-
grees of
stiffness.

On getting a SHIP under Way.

wards as near that trim by stowage as circumstances will permit; by making nice observations how much the ship is made to heel when hoisting the long-boat in and out, or in the tackles a long side, clear of the water, which is supposed to be smooth, and the ship quite upright, when the experiment is tried; and the remarks how much the ship is made to heel, may be made by various ways, as by water upon deck standing in particular places, or running over from one side of the deck to the other, by making marks at the water's edge without board, by measuring the different heights of the gunnels, in the broadest part from the water's edge, by a plumb-line in the highest vacancy within board, from any fixed thing above, and down in a vacant hatchway, or the middle of the after part of the companion, to the cabin deck, or bulk head of the cabin, or from the middle of the fore or after part of the mizen-top upon deck, &c. and it would be well to set down the remarks in a log book, with the draft of water, and the ship's behaviour at sea each time the experiment is tried, which in time, by taking pains, might become of great service. In the above mentioned ship by this practice, would be found a very sensible difference, by her heeling more when loaded with timber, than with coal, as above mentioned. In case she was to load lead, or iron, a judgment might be formed by this experiment, how the stowage would answer, so that in this, or any other ship, where there had been sufficient experience, by this practice, the stowage might be altered as occasion might require, before she went to sea. Where ships are too stiff, or too big for the long boat to be heavy enough for this purpose, the long boat might be filled with water, to a certain height, each time: and in ships of war, might be added to the weight of the long boat, a certain number of guns, by being run out on one side close over to the other; and they might alter her trim as experience might require, by stowing the iron or heavy ballast, higher or lower, in the main body of the ship, &c.

On getting a SHIP under Way.

To fail
with the
flood tide,
recom-
mended.

IT is supposed that the ship is now stowed and trimmed to the best advantage and that every thing is ready for sea. If it be in a tide way, and a leading wind that a ship can stem the tide, it should be a rule, when the tide serves, to get under way and sail against

against the flood, which gives time to get in the moorings, or the anchor up, and stowed away at pleasure, and the ship may be steered without danger in little room through a crowd of ships, should any be in the way, and through narrow or shoaly channels with a flowing tide; by which means many dangerous risks may be avoided.

To prevent the difficulty that often happens in getting the anchor, when it blows fresh with a windward tide, when the tide first sets, or make right to the windward, the cable should be hove in as it flacks, till the anchor is apeak, before the ship swings end on to the tide, to bring the wind aft, that may keep the ship a head of the anchor, with the cable so tight under the bows and bottom, that it cannot be hove in, without breaking the ships sheer, by putting the helm hard over, first one way then the other; this flacks the cable, so that it may be hove in briskly, for the time the ship sheers broad side to the tide, from one side of the anchor to the other, but the ship is liable to get so much head way in the time of sheering, as makes her bring up with so powerful and sudden a jerk, that I have had the experience of breaking the cable by this practice in the Downs, which obliged us to stay there with a fair wind, to get our anchor again.

On getting under Way with a LEE TIDE.

WHEN under the necessity of getting under way with the wind and tide in the same direction, and ships or shoals lie near right a stern, dangerously, in the way you are to go; in such a situation, or any other that happens to be dangerous, I would recommend, where time would admit of it, to call every capable officer to look about with attention, where the danger lies, to consider and consult what is best to be done, and what can be expected for the ship to do, on the occasion, and especially if there be but little wind; suppose it to blow at the rate of six miles an hour, which, at an anchor, will seem a commanding breeze; but it should be considered, that if the tide runs at three miles an hour, when the ship is under way she will loose one half of the wind's power, which may hinder her from performing what may be expected from the most dexterous management. And after the opinions are heard, the intended method of proceeding, should be made

The method of proceeding to be made known.

To consult the officers.

ON THE H E L M.

necessary, made known, that none through ignorance may hinder, but that occasions all may know how to help to put the design in practice, whether recommended. the ship is to be shot a-head, or backed a-stern of the danger. This might contribute greatly to prevent loss or damage, frequently caused by weighing the anchor, and proceeding without thought of the difficulties that attend getting a ship safely under way, in narrow or crowded places. Making a stern board is frequently necessary, and the best management depends greatly on the ordering of the helm, the effects of which, on these occasions, I shall endeavour to explain.

ON THE H E L M.

WHAT we call the helm is the tiller, that turns the rudder on each side of the afterpart of the keel and sternpost, for the water to act upon, as the management of the ship may require; and as ships differ in breadth abait, so should the tiller in its length; that is, the tiller should be just long enough to reach close over to each side, when the rudder stands at an angle of thirty three degrees, or bears three points of the compass from the direction of the keel, which is generally allowed to answer best, as I have before observed and proved by experiment, page 48, where I have already noticed the absurdity and uselessness of putting the helm too far over, and that the rudder ought not to traverse less than thirty three degrees, though in many it was found not to traverse more than thirty, and even twenty eight degrees,) that none of its utmost power might be lost, because it is often wanted on the most important occasions, when safety may depend upon it.

MOVING the helm can have no effect to manage a ship but when she passes, through the water, or the water passes by her, in a tide or currents way, and then the water, gives equal power to the helm, as if the ship went at that rate through the water.

WHEN the helm is amidships, the rudder can have no effect to turn the ship either way, as it then stands in the same direction with the keel and sternpost: but suppose the helm put to starboard, it turns the rudder towards the laboard side of the ship, which makes the laboard side of the rudder to resist the water, which acts with a power according to its velocity, or the ship's head

The effect
of the wa-
ter upon
the rud-
der.

headway through the water, against the laboard side of the rudder, to turn the ship's stern to starboard, and consequently her head to port, and the centre of this turning motion is allowed to be at the ship's centre of gravity, as mentioned page 18. It may easily be perceived, when the helm is put hard a port, how it acts from the same causes to turn the ship's head to starboard, as may be seen by looking at plate 7th, where the plane of a ship, in three different situations is represented with the helm hard a port, which makes it evident that when the ship has headway the water must act against the starboard side of the rudder, in a direction, so as to turn the ship's stern to port, or towards that side the helm, or tiller is put upon, and her head to starboard from that side that the helm lies, as above mentioned.

On the Helm when a Ship has Sternway.

THIS deserves particular notice, the most masterly management depending upon it, on very important occasions, as will appear hereafter.

WHEN a ship gets sternway through the water, the helm has just the contrary effect upon the ship, to what it has when she has headway; as may be perceived by the above mentioned figures, plate the 7th, figure 2, with the helm hard a port, when the ship gets sternway, the laboard side of the rudder, in that direction, is the first part of the ship that the water acts against, and it causes such a resistance, as to have a powerful and ready effect to turn the ship's stern to starboard from that side the tiller lies, and her head to port, that is always towards that side the tiller is put upon, whether to starboard or port, which should be strictly attended to on all occasions, when a ship is about getting, or has got, sternway through the water.

To cast a Ship upon the Larboard Tack, and back her a stern of Danger, as above mentioned.

SUPPOSE a ship at a single anchor, situated as mentioned in page 72, the wind and tide being both in the same direction, and ships or shoals lying near right a stern, in the way you must go, and to keep clear of them, it requires to cast the ship upon the larboard tack, and make a stern board. (In all these proceedings I speak of a three mast ship, and the main braces leading aft.)

IN trading ships, it requires all hands to heave up the anchor, therefore all the necessary sails should be made as ready as possible, the three topsails hoisted, and the yard braced sharp up, with the larboard braces, and the mizen hauled out, before weighing..

In this situation, you have only to attend the helm, and put it a port, when the anchor weighs; the tide running aft, acts against the starboard side of the rudder, and in that direction, will cast the ship the right way; and bring the wind upon the larboard bow, which may be kept so, at pleasure, by the helm, till the ship begins to get sternway through the water, which should be strictly noticed, to put the helm hard a port, or a weather; which puts the plane of the ship in a position, as represented plate the 7th, figure three, and suppose, the wind on the larboard bow, with the topsails aback, which will soon give the ship sternway through the water, and will act against the larboard side of the rudder in that direction, and will have great power to prevent the ship from falling too fast off from the wind, and by the anchor under the bow, while it is heaving up, and the foretopsail kept shivering, she will drive, as the ship is represented plate the 3d, figure 2, by which means it may be supposed that she has drove past, and kept clear of the danger, or of the ship, figure 4, and has got the anchor up, and room to ware, and get before the wind, as represented figure 1, in the same plate.

The advantage of making a stern-board.

THUS making a stern board, gives an advantage in getting underway, as above, from a single anchor; as the anchor heaves up easier when the ship goes a stern, and at the same time it is heaving up, it helps to keep the ship's head to the wind, which will continue the sternway the longer; but notwithstanding, all these helps, it is well known from experience, that a ship cannot be steered long, stern foremost, under sail, so as to keep the wind before the beam, and then the sternway, the power of the weather helm, and her falling off will all cease at the same time: and the ship will drive broad side through the water for a little time, as represented

presented figure 2, plate the 3d, till she gets headway; which is a proper time to ware, as above mentioned, if the anchor is close up; but when there is little room to ware, I would not wish to attempt it, (if it can be avoided) till the anchor is hove quite up, for many ships have been run on shore, in attempting to ware, by stress of head sail, whilst the anchor is heaving up.

To cast a Ship upon the Larboard Tack, and shoot her by the Wind a head of Danger.

BUT let us suppose that from the above situation, instead of backing a stern to clear a danger, it requires the ship to be shot a head, and that there is but just room enough, close by the wind, to clear a danger that lies in the way to leeward. As suppose the ship, figure 2, plate the 5th, could not be got underway with safety, without shooting a head of the ship figure 1. To proceed with safety from such a situation, much depends on the anchor being hove briskly up, after it is out of the ground, and having proper sails ready to set to the best advantage. The three topsails must be hoisted and the yards sharp braced up with the larboard braces forward, and the starboard braces aft, when the anchor is at a long peek, so that at weighing the anchor, you may have only the helm to attend: putting it hard a port, the tide will act upon the rudder, and the foretopsail being braced sharp up with the larboard braces, will readily cast or box the ship off, the right way, so as to fill the after sails, when the foretopsail may soon be braced about, and fill'd, before she gets sternway, and the helm may keep the ship under command, to steer her by the wind a head, clear of danger. But if the ship gets sternway in casting, the helm should be kept hard aweather, to prevent her from falling too much off from the wind, and when she gets headway again, you should be very cautious how you ease the weather helm, with the anchor, much below the bows, which increases the resistance forward, and may bring the ship up in the wind, so as to prevent her shooting clear of the danger, which should be guarded against by the weather helm, and head sails, as jib and fore-top-mast stay-sail, &c. As soon as the ship is shot far enough a head, to clear the danger, to lee ward, and there is but little room, a head, it is certainly best to bring the ship to, and drive with the helm a-lee, with the main and mizen topsails aback, and the foretopsail

In case of
getting
sternway.

shivering, as represented plate the 3d, figure 2, till the anchor is up; then take proper time to ware, as before recommended.

To cast a SHIP on the Larboard Tack, when riding in a Tide, with the Wind two Points on the Starboard bow.

SUPPOSE a ship riding in smooth water in the stream of a tide, with the wind two points on the starboard bow, and so near the shore on the larboard side, that she must be cast upon the larboard tack to clear the shore. I have cast a ship on the larboard tack from the above situation, by the common method of proceeding, as mentioned in the last case, having the three topsails hoisted, and the yards sharp braced up, with the starboard braces aft, and the larboard braces forward, with the starboard fore-top-bowling well hauled, and at the anchors weighing, putting the helm hard a port; the tide acting upon the rudder, and the wind upon the sails braced in that direction, brought the ship about, with the wind on the larboard bow, before the got sternway, which should be always strictly noticed, for in all proceedings of this kind, if a ship gets sternway, before she brings the wind right a head, you may be sure that she will not come about the right way. In that case it must be the surest way, directly to veer away cable, and bring the ship up again, and carry out a small anchor, on the larboard bow, taking in the rope, and hauling it tight, on the larboard quarter; when the bower anchor is apeak; or you must lie till the windward tide makes, to bring the wind on the larboard bow, when you may get underway, and clear the shore.

To cast
by a small
anchor.

To cast a SHIP on the Larboard Tack, when riding with the Wind right a head, and to ware her short round, before the Wind in little Room.

IN this case, the head sails only should be loose, viz. the fore-top-sails hoisted, the fore-sail in the brails, braced sharp up with the larboard braces, the jib and fore-top-mast-stay-sail set with the larboard sheets flat aft, when the anchor is apeak, and if there is a lee tide running, at weighing the anchor, the helm should

should be put a port, so far as to bring the wind a little on the larboard bow, which should be kept so, by steering the ship till the tide ceases to run aft, which should be strictly noticed by the water along side, then put the helm hard a starboard, or a lee, and when the ship gets sternway, the water will act very powerfully on the starboard or lee side of the rudder, in that direction to turn the ship's stern to windward, whilst the wind acting at the same time upon the headsails, aback, will box her round off, upon her heel, so as to bring the wind almost aft, by the time she loses her sternway; then the ship will cease falling off, and soon get headway; which should be attended to, and the headsails be braced about flat, with the starboard braces, and the helm shifted hard a port at the same time.

WHEN there is no tide, but the water still at weighing the anchor, the helm must be hard a starboard, and as the ship gets sternway, the water meets with so much resistance against the starboard side of the rudder in that direction, that the rudder acts with great power to turn the ship's stern round to port, and the headsails being set and trimmed as above mentioned, and the fore-sails let fall with the starboard bowline hauled close forward, will contribute to cast the ship the right way round so far, by the time she loses her sternway, as that you may then proceed as above directed, and may get the ship under command of the helm to steer at pleasure, as she gets headway. The success of this case depends greatly on heaving up the anchor briskly. From the above it will be easy to know how to cast and get a ship under way upon the starboard tack; the same rules hold good, only to manage the helm and sails the contrary way to that which has been described.

ON TURNING TO WINDWARD.

IT may not be amiss here, to endeavour to explain by what means, and upon what principles it is, that this most noble and useful machine, a ship, is made to gain ground, and is brought about from one tack to the other, against the wind and waves, when they are moderate.

It is well known that we have ships that will sail from six to nine miles an hour, upon a wind, when it blows fresh, and the water is smooth, and will make their way good within six points of

the

ON TURNING TO WINDWARD.

What
makes a
ship gain
to wind-
ward.

the wind, so as to gain to windward, in still water, a third of what they run by the log; suppose six miles an hour to gain two miles, or nine miles to gain three to windward, with the sails trimmed in that oblique or slanting direction as is particularly described page 52, which certainly tends to force the ship much more broadside to leeward, than a head. For it is a known principle, that a ship sailing with the wind upon the beam, and the plane of the sails trimmed to four points, or forty five degrees from the direction of the keel, the sails at that angle tend equally to drive the ship broad-side to leeward as a head; so that a ship's sailing and turning to windward as above mentioned, must be owing to the shape of the ship's hull, which makes little resistance on sailing a head, compared with the great resistance made by the broadside in the water, not only by the ship's extraordinary length in proportion to her breadth as has been observed, but all those thin parts, the dead wood, cutwater, gripe, stem, keel, sternpost, and rudder, which make very little resistance in the ship's going a head, but a powerful resistance sideways; so that though the sails are trimmed in that sharp direction, yet in a moderate wind when the ship can carry all her sails, by the wind and the water smooth, she will sail with the wind two points before the beam, as fast, and faster than she will right before the wind, with the same breeze. Thus suppose the wind blows at the rate of ten miles an hour, when a middling stiff, fast sailing ship may carry her top-gallant-sails in smooth water, and sail at the rate of six miles an hour, and gain two points to windward, which increases the power of the wind one sixth part, and makes it act equal to twelve miles upon the sails close by the wind, and if you put right before the wind so that we will suppose the ship to go about five miles an hour, this reduces the power of the wind one half, and it has not one half of the canvas to act upon that it has when the ship is sailing close by the wind. To confirm this opinion, I have tried experiments, and found the velocity of the wind in a pleasant breeze, by a man running on the shore right before the wind, so as to keep a light vane in his hand becalmed, when he run with a log-line fastened to him, five different times, to be about nine knots; I then tried a schooner rigg'd boat with two sails close by the wind, and found that she sailed, by the same log-line, five knots, at five points from the wind; then I put her right before the wind, and tried her with both sails drawn full, when she went but the same five knots by the log in three different trials,

before

before and by the wind, at the rate of five miles an hour, when the wind blew at the rate of nine miles an hour; I reckon that a fast sailing ship would have gone as fast or faster than this boat, at six points from the wind, with her principal sails braced up to three points of the wind, as before observed, which is sharp and near enough to the wind, for a three mast ship, that has more top-hamper to hold wind than a sloop, or a schooner rigged vessel, and therefore requires to sail farther from the wind, to overcome all the resistance that is against her: and a ship makes more or less lee-way in proportion to her headway, on which depends the power of the helm, to steer and bring her about from one tack to the other, in the most advantageous manner, so as to gain ground to windward. I have, in chafing to windward, been coming fast up with many a vessel that sailed much nearer the wind than ours; for it should be considered that a ship sailing at six points from the wind, nothing but the sails properly trimmed contributes to give her headway, and all other parts of the ship or her materials, that the wind and waves act upon, tend (two points out of eight) to give her sternway, and the wind may be said to be reflected, so as to act upon the after part of the ship, as if it was only three points from being a head, as may be perceived by the fly of the ensign, and the after sails upon the mizen-mast standing at an angle of only a point and a half from the direction of the keel, as mentioned page 53. Therefore to trim a ship's sails to steer nearer the wind than six points, must tend to lessen her headway, and in proportion increase the lee-way, so that there must be more lost than gained by this practice, except in a very narrow river, where it may prove sometimes necessary.

ON TACKING AND TURNING TO WINDWARD.

THIS excellent property of a ship turning to windward, and tacking or staying well, depends greatly on her dimensions, the shape of her bottom, and her being trimmed; and I reckon a ship is in the best trim for tacking, as well as sailing, both by the wind and large, and is the most manageable on all occasions when she will almost steer herself close by the wind, under all her principal sails, carrying the helm near a midships with a trembling motion. This a fast sailing ship will often do, when it blows freigh

An experiment of a rudder fixed to the stem of a sailing boat.

On a ship's fresh and the water smooth, though two thirds of the canvas (as I have counted) stand before the mainmast, and a good deal of it over the bows, upon the bowsprit and jib boom, when there is none which projects over the stern, except part of the long boom mizen, which has lately become the practice, and which I look upon as an improvement. When a ship carries the helm a lee at such times, it is a sign that she is too much by the stern, or the masts are stayed or stand too far forward. But when a ship is not enough by the stern, or the masts rake or stand too far aft, she will gripe, and carry the helm a weather, which is thought by many to be an advantage in turning to windward. This opinion I have heard refuted by a very plausible experiment, tried on this account, by fixing a rudder to the stem of a sailing boat, so that it could be pointed to windward occasionally on either tack, thinking this would make the boat carry her proper helm a weather, and the water would act upon the lee side of the two rudders, in a direction so as to cause her to gain more ground in turning to windward: but it was found from experience to increase the resistance a head, and that it did more harm than good. I have experienced great advantage from suiting a ship with more head sail than after sail, to ease the weather helm, when chased by a much superior force at a small distance to leeward, carrying a pressing sail close by the wind. At such times it may be perceived how much the water is raised above its natural level before and on the lee bow, and you may see a hollow, below the level on the luff of the weather bow, by the headway; and the ship heeling to the pressure of the sail makes a fuller water line to leeward, than to windward, consequently a greater resistance on the lee than the weather bow, which is the reason that ships in general require so much more head than after sail, and to swim so much by the stern to be in the best trim to steer, and be under command of the helm so as to make them most manageable.

SHIPS lightly ballasted, or an extraordinary length, are very uncertain, and require extraordinary attendance and time in tacking, (as is mentioned page 24,) whilst a shorter well proportioned ship in a good trim for turning to windward, may come about so fast as to make it difficult to work and manage the sails, so as to get them properly trimmed in due time.

To tack a Ship when in a dangerous Situation by a rough Sea, or when her Trim, or her Property, is such as may make her Staying doubtful.

SUCH circumstances certainly deserve attention, as safety may depend upon management; every thing should be ready and clear, the people properly stationed, the sails fairly trimmed, the ship cunned and steered just full and close by the wind, and if it is a rough sea take the advantage of the first smoothest time, when the ship has as much headway upon her as can be expected. To haul down the jibb, if set at such times is of great service, and not to put the helm a lee all at once, but luff the ship up by degrees to shake the sails; and not till then, order the helm hard a lee with a loud voice, to let go the lee sheets forward, but not the lee braces and fore-top-bowline, as in common, to back the head fails too soon; that stops the ship's headway, which must continue to give power to the helm till the wind is brought a head, else you may be sure the ship will not stay. To off tacks and sheets, and haul mainsail when the wind is a point on the weather bow, this swings the yards sharp round, that the main tack may be got close down, whilst the head fails becalm the fore leech of the main and main-top-fails, at the same time the wind blowing astern on the after leech of these fails, acts jointly with the rudder to turn the ship's stern, so as to bring her about the right way, as represented by figure 1, plate the 2d.

WHEN a ship comes about, at such times she is sure to have sternway, by the time the head fails are hauled; therefore the helm should not then be shifted a lee, as is commonly done, but should be kept hard a-weather till her sternway ceases: the water acting upon the weather side of the rudder prevents the ship falling round off from the wind, which the helm when hard a lee occasions while the sternway continues; and strict notice should be made by some object a head, or by the compass, that the ship continues coming about till the wind is on the other bow, for if the stops with the wind a head, and by the water along side her headway is perceived to be done, the helm should be directly shifted to the other side, so that by the sternway the water may act upon the rudder and bring her about the right way, and then the helm should not be kept a lee, but immediately shifted, and kept hard a weather till her sternway ceases. For the reason already given,

the head sails may be hauled as soon as possible, for the ship will be sure to fall off the faster, and farther in proportion to her sternway, so that the weather braces should be tended to prevent the head yards flying fore and aft, as they will do if it blows fresh, and to keep the head sails shivering, that the fore tack may be got easily close down, the ship stopt the sooner from falling off, and shifting the helm a lee when the sternway ceases, the head sails may be trimmed sharp as the ship is perceived to come to.

To tack a quick-turning SHIP in a fresh Gale, and smooth Water.

A GOOD or bad haul in this case makes a material difference in gaining to windward, and in wear and tear, and in the ease of the people. I have been in a ship, where when hauling mainsail, it was always catched a back, as is represented figure 2, plate 2d. so that we had the maintack to get down five or six feet, and the after sails to trim after the ship was tacked; and that this is often the case, may be seen from the common print of a ship tacking, where it is represented in the same manner. This is owing to the custom of always putting the helm hard a lee whether the ship requires it so far or no, and not hauling the mainsail till the wind is right a head.

THEREFORE to make a good haul at the time, when it is known that the ship will be very quick in stays, the helm should not be put hard a lee, as customary, but half down a lee, less or more, as experience proves to be sufficient to bring her about before she loses her headway, to off tacks and sheets as soon as the sails shake that the mainsail may be hauled, with the wind two points on the weather bow, as represented figure 1, plate the 2d. This management helps the ship in stays, and gives time and a favourable opportunity to get the main tack close on board, and the after sails fairly trimmed by the time they fill, so that the people may be all at liberty to haul and trim the head sails; then the helm should be shifted, or righted only, as the ship may require, by her head or sternway, to work her close, and not always hard a lee, as customary; for if the ship has headway, it may bring her up in the wind; and if sternway, it may make her fall broad off from the wind, as before mentioned.

IT must be allowed, that the less helm a ship is tacked with, so as she does not get sternway, the further she will shoot and gain to windward

windward in stays, for the rudder stops the ship's way through the water more or less, in proportion as the helm is put over to either fide, as appears from the experiments I related page 47. And as to a ship coming about with little helm, it is well known that will often happen when not intended, by a small neglect of the helm.

In narrow channels, where a ship has very little room to turn to windward, she may require the helm to be put down hard a lee, all at once; and the lee braces forward, sheets and fore-top-bowline, all to be let go at the same time, also to brace the head-sails, which may prevent the ship shooting a shore in stays. When this happens the mainsail may be hauled with the wind three points on the weather bow, when the after sails shake, and the headsails take aback, by being braced to, which will give more time to get down the maintack, and to trim the aftersails without hindering, but rather helping, the ship's stay, as before observed. For suppose a ship was to be launched head foremost, with her square-sails set and trimmed sharp, with the larboard braces forward, and the starboard braces aft, and with the wind three points on the starboard bow, as represented figure 1, plate 2d. it is evident from thence that the wind would act whilst the headway continued, so as to turn the ship's head to starboard; and on the aftersails to turn the stern to port, which would bring her round on the larboard tack, though she had no rudder hung, or if she had her helm amidships, by the effect of the sails only.

But the best lessons for tacking, and working to windward in little room, are in the Colliers bound to London, where many great ships are constantly employed, and where wages are paid by the voyage, so that interest makes them dexterous, and industrious to manage their ships with few men, in a complete manner, in narrow channels, more so than perhaps in any other trade by sea in the world. The seamen there go regularly from one thing to another, which they know depends upon them, by the great practice they have in turning to windward against westerly winds, through narrow and shoal channels, with their deep loaded ships, which are trimmed near an even keel to make them draw as little water as possible, and their main-masts stand farther aft than common; this occasions them to gripe, which often obliges them to work the spritful and all the headsails they can bear, to make them manageable when turning to windward. In narrow channels, when it blows so strong that all hands cannot haul aft the fore sheet, but are obliged to heave it ast by the capstern, even then it

Tacking
in very
narrow
channels,

On work-
ing to
windward
in the coal-
trade to
London.

would be looked upon as a great blunder to make a bad haul, observing always the ship's quick or slow motion in stays, to off tacks and sheets, so as to be all ready, and haul mainsail in the proper time, whilst the wind takes the back of the weather or fore leech of the main and main-top-sail, which swings them sharp round, with the main sheet block close aft, and the main tack on the other side, close forward to the cheftree or the tack hole, so that they have only to haul in the slack of the maintack and sheet, and trim the after-sails whilst becalmed by the head-sails, so that all hands are at liberty to help to haul and trim the head-sails, when the weather requires it.

IT must be allowed, as mentioned page 52, that these ships being adapted for this trade, are rigged as light as possible, to make them work easy to windward in narrow channels, with few hands; they have no lifts to the lower yards, no fore-top-bowlines; and have short main-bowlines, and snatch blocks for the main and fore-sheets: the main braces lead forward, so that the main and main-top-bowlines are hauled and belayed to the same pin, the same way with the main brace, so that one man easily lets them all go together at once when the maintail is hauled, or rather swung so sharp round, by the wind, as above mentioned, with so swift a motion that though they haul every thing hand over hand, they can only get in the slack of the main-top-bowline by its going fingle, which they make fast to keep the sails thus swung sharp round, till the main tack is got down, and the yards braced up, they then haul the bowlines upon the main brace, for the reasons given, and the ships being trimmed near an even keel, with the main-mast standing far aft, as before remarked, makes them work close, by preventing them falling much off from the wind, though they may have lost their headway, when the head-sails are hauled: And they are mostly built with pink sterns, rounding inwards in their upper works, so that they trim the sails to stand full within five and a half points of the wind, and have so little top-hamper above water, to hold wind, in proportion to other ships, that when turning to windward in narrow channels, they beat ships that would beat them in the open sea, which must be owing to such reasons as have been given: and in order that the running ropes may run clear in making short trips, they dont coil them up, but they let them run as they were hauled.

SAFETY depends greatly on getting a ship at first fairly underway, and where there is water enough, it is certainly best to heave short upon the anchor, and weigh with the first of the tide's making to windward. And if the wind is partly across the tide, it will cast the ship with her head towards the weather shore, which she may be kept clear of, by driving with the sails aback, as represented plate the 3d, figure 2d, till the anchor is up and stowed. And as the tack towards the weather shore is the shortest, it is prudent to back as near the lee side as you can with safety, to make the first board the longer, to get the proper sails fairly set, and to get all ready in time for tacking, and to make as bold as possible with the weather shore, on which side a ship is always surest in coming about, and in case of missing stays, a ship may be backed off from the weather shore, as above mentioned, till she has room to fill and set the sails, and get all her headway to try her in stays again, without any danger. But when the ship is got about to stand towards the lee shore, where she is not sure in stays; when going slanting with the tide, as going across it, and especially if there run any waves that may hinder the ship staying, and not being sure of all the ropes running clear upon this tack for the first time, it may be necessary to put the ship in stays in good time, that, in case of a miss, there may be room enough to fill and try her the second time, or to use such means as may prevent her going on shore.

BUT when the wind is right against the tide, which begins to make to windward, it requires caution, not to weigh the anchor till the ship swings end on to the tide, and brings the wind so far aft, that she may be steered right against the tide, till the anchor is up and stowed, and the sails with which the ship is to work are all ready; as represented figure 1, plate the 3d. And to haul the wind from being clole over to one side, which gives the whole breadth of the channel, to get the ship fairly underway, close by the wind, and ready for tacking, let the first trip be made as short as possible, till it is found how the ship and people work upon both tacks, and make them longer or shorter boards accordingly afterwards; but care should be taken not to stand into an eddy tide on either side, which may be perceived by a rippling, which has often occasioned ships to miss stays and go on shore.

THERE is a saying amongst seamen, if a ship will not stay, you must ware her; and if she will not ware, you must box-haul her; and if you cannot box-haul her, you must club-haul her; that

that is, let go the anchor to get her about on the other tack; each of these masterly performances deserves particular notice.

ON BOX-HAULING A SHIP.

MANY advantages as well as safety, often depend upon this being put properly in practice; for it often happens, that a ship refuses stays, when there is not room to ware in time, so as to avoid danger, by the common method of filling the head, and shivering the after sails, &c. Therefore whenever a ship in a dangerous situation is put in stays, and it is perceived that she stops coming to, before she brings the wind a head, it is then certain, that she will not stay, therefore she should be immediately box-hauled, by keeping the helm hard a lee, and haul off all; bracing about the head as well as the after sails, hauling close forward the lee fore and fore-top-bowlines, and up mizen, and down after stay-sails at the same time; the wind will then act upon the sails thus aback, and the water upon the lee side of the rudder, by her stern way, will box the ship short round, upon her keel, with her stern up to the wind, far enough aft for the after sails to draw full the right way to act with the helm, which must be shifted hard a weather, when the sternway ceases; so that the headway with the wind so far aft, will readily bring the ship round on the other tack. The main and fore tacks are easily got down when the wind is upon the quarter, and shivers the sails, the main sheet is easily hauled aft, and the after sails braced up and trimmed sharp, as the ship brings the wind more aft, which helps her round the faster, till the wind comes on the other quarter, that the mizen and mizen-stay-sail may be set to take the right way, to bring her to the wind, whilst you tend and trim the headsails, as she comes to.

Why a
ship loses
little
ground in
box-haul
ing

BOX-HAULING may be proved to be the surest and readiest method to get a ship under command of the helm and sails, to answer many occasions in little room, as well as ware, and bring her from one tack to the other, with the least loss of ground, to leeward, when a ship refuses stays. Nice managers of sloop rigged vessels, turning to windward in narrow channels, when they want but little to weather a point, rather than make another tack, have a practice of running up in the wind till the headway ceases, then they

they fill again upon the same tack: this they call making a half board. Thus a ship in box-hauling may be said to make two half boards, first running with her head, then with her stern up in the wind, by which two motions, a ship if well managed, rather gains to windward, and brings the wind almost aft, by the time the sternway ceases, so that she is under the command of the weather helm, and the after fails, to bring her short round, on the other tack, with the first of the headway, in which time only it is the ship goes any thing to leeward worth notice, in box-hauling; therefore it should always be put in practice on those occasions, by putting the ship in stays, though it is known she will not come about with her head to windward; and in a gale of wind and high waves, or when there are not people enough to manage and haul the headsails, the aftersails only may be hauled, and the fore-sheet hauled cloic aft again, when it is perceived that the ship has done coming to, as is represented plate 7th, of a ship imbayed on a lee shore, which shall be spoken of in its place.

ON CLUB-HAULING A SHIP.

THIS is to get a ship from one tack to the other, by letting go an anchor, when by an eddy tide, or by a rough sea, or being out of trim, or from any other cause, she refuses to stay or ware, in time to avoid danger. When this happens in shoal water, found by the lead, that if the ship has not water over her anchor, she would have sternway given her, and not headway when the anchor is let go, and the weather anchor is likelier to go clear of the ship than the lee one, therefore both bower anchors should be ready on these occasions.---Turning to windward, at sea, will be noticed hereafter, when treating on making of passages.

On a SHIP driving to Windward with the Tide.

IT often happens that there is not room to turn a vessel to windward through a crowd of ships, or in narrow channels, but she must drive by the help of the windward tide.

A SHIP

On a SHIP driving to Windward with the Tide.

A SHIP in this situation, must be managed, according to the manner you design to proceed, for if the tide is strong enough, in proportion to the wind, so that the will drive fast enough to windward, stern foremost, it will certainly be the best, as it may be done with or without any sails set, the yards being braced sharp up, as represented plate the 3d, figure 1. A ship may be steered at pleasure, and to a great nicety, end on to the tide, and she will drive stern foremost in less room than her own length; but it will require above three times her length to drive broad-side, if the wind is right against the tide; and dexterous management is required on such an occasion, because a ship will always shoot and tend towards that shore a head of her, so that you cannot drive far upon one tack, though with the sails a back, without waring at times, to drive on the other tack, or the ship will shoot on that shore a head of her, of which I have seen instances in spite of all endeavours to back a stern; the reasons of which appear to me to be as follow.

Reasons why ships shoot a head more than they can be backed a stern, when driving broadside with the tide, tho' the sails are aback.

SHIPS in general have a longer and sharper run aft than they have an entrance forward, the sternpost and rudder stand more upright, than the stem and gripe, and they swim more or less by the stern; therefore the after part of a ship must be more powerfully acted upon by the windward tide, than her fore part in the water, which consequently sets her stern more to windward than her head, which at the same time is more acted upon by the wind above water than her stern, in proportion as the forecastle, and all belonging to it, is larger and stands farther forward than the mizen-mast stands aft, and the bowsprit, with the jibboom, and all that belong to them projecting so far over the bows, and nothing projecting over the stern to hold wind, in the same proportion a baste, they must naturally cause the ship to drive with the wind mostly a baste the beam. And though the most effectual means are supposed to be used on such occasions, to keep the ship's bow to the wind, and prevent as much as possible her falling off and shooting a head, by letting her drive with the aftersails flat a back, the mizen hauled out, the helm a lee, and the headsails kept shivering, as is represented by figure 2, plate the 3d. where it appears as if a ship might be backed a stern at pleasure, yet experience proves the contrary, and the following reasons may be added to those above mentioned. The helm must be kept a lee, when driving in this way, and though the aftersails are aback, the ship will shoot a head, and back a stern alternately, but she will come to with a flow

slow motion, by her headway, till she brings the wind before the beam, which gives her sternway and makes her fall round off upon her heel, with a quick motion, and brings the wind so far abaft the beam, that she soon gets headway again, so that she will shoot much farther a head than she backs a stern, which makes it difficult to drive broadside with the tide, right against the wind, in little room with safety,

To drive a SHIP Broadside to Windward, with the Tide right against the Wind.

IT is a masterly and necessary piece of seamanship, to be able to perform this with safety; where there is very little room, as is represented plate 3d, where the ship figure 1. by the help of a strong tide, may be supposed to have drove stern foremost, right to windward, where it was too narrow to drive broadside, and to have got where there is but just room and tide enough to drive broadside, which may make a great deal of difference in the ship's driving according to the wind and tide; for if we suppose the wind blows so fresh that the ship cannot be made to go less than at the rate of two miles an hour, through the water, when driven stern foremost, the tide must run at the rate of three miles, to make her drive one mile an hour to windward, but where the tide runs but two miles an hour, the ship will then be at a stand between wind and tide, but when she is brought to, and drives broadside, as represented by figure 2. she may not drive above half a mile through the water; so that what the difference is between that and what the tide goes, so much she will drive to windward.

A SHIP may drive stern foremost without any sail, as she only requires steerage way to command her, and the less way she has through the water, the faster she will drive, so that when it blows fresh, to contrive and make stopwaters may be of service to help her to windward. But to bring a ship to, where there is little room, so as to drive broadside, will require the three top-sails, the mizen, and the foretop-mast-staysail, to be ready to hoist, to make her manageable to back, or fill, stay, or ware, as may be required; for should we endeavour to bring a ship to, without sail to throw aback occasionally, she will perhaps shoot on that shore a head before she loses her headway.

M

Now

On a S H I P driving to Windward with the Tide.

Now let us suppose that the ship figure 1, plate 3d. after driving stern foremost as above mentioned, has set her topsails braced sharp up with the larboard braces, in order to bring to, and drive broadside on the larboard tack. In this case the ship should be sheered as near the starboard shore as she possibly can with safety, then the helm should be put hard a starboard, hauling out the mizen as soon as it will take the right way, so as to bring the ship round to with the topsails aback, to prevent her shooting too near the larboard shore.

A SHIP bringing to with much headway, will bring the wind nearly right a head, by the time the headway ceases; then the helm should be shifted hard a weather, and the sails being aback, will soon give her great sternway, by which means a sternboard may be made to back her as near the shore a stern as possible; for, as it has been observed, a ship driving broadside may easily be shot a head, when she cannot be backed a stern, and this is the only time a sternboard can be made to advantage at the ship's bringing to: for when the sternway ceases, the helm must be put and kept hard a lee, and the ship must drive with the main and mizen-top-sails aback, the mizen hauled out, and the fore-top-sails kept shivering, as is represented figure 2, plate the 3d. and if the mizen-stay-sail was set with the sheet to windward, it might help to keep her more to the wind, so that she might drive the farther on one tack, before you are obliged to ware her to drive on the other tack, which must be done as soon as the ship is perceived to draw near the shore a head, which will always be the case with a ship driving right to windward, for the reasons given.

WHEN intending to ware, as a ship is always coming to, and falling off by her head and sternway when thus driving, take the opportunity, when she has just done falling off by her sternway, as she is then as far a stern as she will be upon that tack, and the wind as far aft, being then all ready up mizen down mizen-stay-sail, (if set) shiver the main and mizen-top-sails, fill flat the fore-top-sail, up jibb and fore-top-mast-stay-sail, (if necessary) shift the helm hard a weather, the tide then setting round the stern, as is represented by the ship's wake and boat to windward, figure 2, it will then act with such power upon the rudder in that direction, that with the first of her headway, the ship may be wareed, and proceeding as before, brought to, so as to drive on the other tack; in this manner a ship may be managed, to change tacks, and drive right

right to windward with the tide, in less room than any one would think possible, who has not had the experience.

BUT instead of waring as last mentioned, I cannot help thinking it would be better to put the ship in stays, filling the after sails flat, keeping the fore-top-sail just drawing full, till the ship comes to, so that it will take a back to help her about, and if she stays, let the helm lie, as it will then be a weather; the ship may then be backed, by making a sternboard towards the shore a stern, at pleasure; and if she refuses stays, it gives a favourable opportunity to brace the topsails a back, and box-haul her round, as has been described page 90, by which she will lose less ground than by waring; and the ship's trim may require this practice, as it is known that loaded colliers will stay when they will not ware, and when light in ballast, they will ware when they will not stay.

THE above management is founded on a supposition that a ship is to drive through a long straight reach, or channel, where the tide runs true right against the wind.

To drive broadside to Windward, with the Tide running a cross the Channel, or, in a River of a winding or serpentine Form.

IN channels where the tide runs a cross through swashes, &c. the ship should be laid to drive with her head towards that shore the tide sets from, and the setting of cross tides is best perceived by some objects which may be found to lie nearly in the direction of the channel; observe nicely how the ship opens or shuts these marks, that the sails may be kept aback, shivering, or full to shoot a head as the tide may require, so as to keep the ship in a fair way.

DRIVING in a crooked or serpentine river, as represented plate the 3d. the tide commonly runs winding like the river, from a point over into a bay on the other side, and out of the bay again past the next point, into the next opposite bay, &c. therefore at the bottom of each bay, where the tide begins to set out again, the ship should be put on the other tack, to drive with her head towards the next point, as represented by the ship figure 2, by which means a ship may be backed a stern, so as to drive clear of the shore a head, upon both tacks.

ON BRINGING A SHIP TO AN ANCHOR.

WHEN the wind blows a point or two of the compasses, across a tide that runs true, a ship driving with her head towards the weather side may be easily managed, so as to keep in a fair way, by backing, filling, or shivering the sails, and the more the sails can be kept shivering, the faster the ship will drive.

THOUGH a windward tide helps a ship to work, and makes her manageable when driving to windward, yet it is very necessary to have an anchor ready to let go, as occasion may require.

ON BRINGING A SHIP TO AN ANCHOR.

VARIOUS situations and different sorts of harbours, roads and coasts, and different directions and strength of winds, waves, and tides, make it impossible to fix certain rules to bring a ship properly to an anchor, at all times and places. Yet in my opinion, a great deal may be said on the subject, deserving notice. ---And first it may be necessary to make some remarks on coiling cables.

ON COILING CABLES.

IT may occasion the loss of a ship, to coil a new cable with the fun, as it is termed, before it is properly stretched, or the end taken through the coil, for it is almost sure to come up in kinks when veered out, and especially in cold weather. The greatest dependance being on new cables, they are commonly kept in reserve till the other cable, or the anchors give way, which makes this bad practice in coiling them the more dangerous; therefore it should be first considered, how to manage the cables, to make them work and coil to the best advantage, and run clear of catch-fakes, as well as kinks.

A CABLE in my opinion, works and wears much better for being coiled the same way that it runs round the windlasses, or bits. Therefore the cables for the starboard anchors, which work round the windlasses against the fun, should be coiled against the fun, and those for the larboard anchors coiled with the fun, as they work that way round a windlass, and as they run out round the bits the contrary way, so that the cables should be coiled accordingly. And
to

to make new cables answer this practice, is, the first time, to coil them with the sun, over the cable tier hatchway, with larger or less fakes, according to the limberness or stiffness of the rope, and take the upper end through the coil, to coil it down in the tier; this will make the rope pliable to coil, and veer out easy, clear of the kinks, either with or against the sun.

To coil a cable to run clear of catch-fakes, the cable should always be laid out from the inside fake to the outside fake, at the farther end of the cable tier, farthest from the hatchway; this will likewise coil the cable so much lower in that part near the hatchway, so as to give more room and height to bend and coil the cable, and for the bends to upset clear when veering away.

THE bad custom of coiling cables with the sun, so as to run in kinks proceeds first from the rope-makers, who for their ease, coil them that way to send to the ship, where, without thought, they are too commonly coiled down the cable tear the same way, because a new cable before it is well stretched, will always bend of itself in that way of coiling, for the rope opening against the lay, gets clear of a turn at the bend of every fake, which is the reason that a new cable bends and coils so easy this way, but when this cable comes to be veered out, this turn must come into the cable again at the upsetting of every bend; but the lay of the rope inclines it to keep clear of this turn, which prevents the fakes from upsetting, and causes it to come up in kinks, by which bad practice I have known many narrow escapes. Therefore all new cable-laid ropes, hawsers, and towlines, as well as cables that require to run clear of kinks, should be either coiled against the sun, till they are well stretched, or with the sun, and the end taken through the coil as before mentioned; for the same reason, as it is well known, that a coil of new rigging will not run clear of kinks, without the end is properly taken through the coil. But to coil a new cable against the sun, that is, from the right hand to the left, requires a turn to be forced into the lay of the rope, at the bend of every fake, which makes the bends upset of themselves, so that the cable veers out very easy.

Now if we may suppose that the anchors and cables are all ready, so as to be sure of running clear, the next things to be considered, are the depth of water, the room, strength of the wind, waves or tide, where you expect to anchor; also that the buoy, and buoy-ropes, range of cable, handspikes, stoppers, ring-ropes, and buckets of water to throw on the windlasses or bits, be all ready,

ON BRINGING A SHIP TO AN ANCHOR.

ready, as occasion may require, and to give as great a scope of cable as the place will permit, before you offer to bring the ship up, because the length and weight of the cable, will contribute greatly to ease both the anchor and cable, as well as the ship, when the waves run high, for which reason, I have known ships have the inner ends of the sheet, and best bower cables spliced together, so that by oversetting one cable, they could veer out both upon one end, to either anchor, if necessity required it, for it is well known, in a storm when the waves run high, and especially in deep water, that a ship will ride much easier and longer by two cables, or more upon one end, to one good anchor, than by two anchors with a single cable to each. For to ride by two anchors, they must lie far enough asunder on each bow, to prevent one anchor from hurting the other cable, by which means a ship seldom pulls hard upon both cables at the same time, but first pulls hard upon one cable; if but a short scope, it plunges her deep into the sea: then that strain draws the ship towards that anchor, which slackens that cable; so that by the next wave she strains hard upon the other cable, and so on, she pulls first at one and then at the other, which causes a ship to labour, and be very uneasy in the waves, in comparison to what she would be, if riding by one good anchor and a great scope of cable, which admits the ship to fall and rise easy with the waves, without hauling the whole length and weight of the cable off the ground, which makes the anchor hold longer without coming home.

In letting go an anchor, care should be taken that the ship does not hurt herself upon it, in case of shoal water, and that the anchor is not fouled by the cable getting about the fluke or stock of the anchor, which may prevent its holding the ship when any strain comes upon it.

To come to an Anchor when the Wind is right against the Tide.

IT should be a rule to shoot the ship a head of the anchor, or sheer her clear of it, upon the same tack you design to shoot her upon, the next tide, endeavouring always to keep the ship in swinging with the tide on one side of the anchor, to keep clear of it, for reasons that will be given in their place on keeping a clear anchor. As is represented plate the 3d. it may be supposed that the

the ship driving to windward has got to an anchoring birth, or the tide is so far spent that she will drive no farther to windward, and must come to an anchor on the starboard tack. In this case at letting go the anchor, the ship should be shot a head of it, and kept a head with the helm a weather, and the yards braced full with the larboard braces, and the fore-top-mast-fay-sail and mizen set full, as is represented by figure 3, plate the 3d. till the windward tide is done, that she falls to leeward and rides windroad, with the wind, anchor and cable right a head, as represented figure 4, plate the 3d. in which position she will lie clear of the anchor till the next windward tide.

To come to an Anchor when going with a strong Wind and Tide the same Way.

W H E R E there is room, it is certainly necessary to furl the square-sails, as the ship is running before the wind and tide, and to bring her to, by putting the helm hard over to starboard or port, and haul out the mizen to bring the ship's head up as much as possible, against the wind and tide, at letting go the anchor, which will contribute greatly to bring the ship up with safety and ease, compared with that bad practice of letting go the anchor as the ship runs right before the wind and tide, without handing the square-sails, which adds all that extraordinary force of the ship's way through the water, to the strength of the wind and tide, and thus increases the strain and rubs the cable to a dangerous degree, by which I have seen great damage done, as breaking the cable, &c. which might have been avoided by bringing the ship to, and letting go the anchor, as above recommended.

T H E damage that is often done on this occasion, proceeds from want of consideration; for as it has been observed before, a ship sailing right before the wind, and a strong tide, does not feel the real strength of the wind; therefore apprehending no danger, they let go the anchor as the ship runs, which if it does not make something give way, must greatly strain every thing that is immediately concerned in bringing the ship up.

To

To come to an Anchor, with the Wind right a cross the Tide.

WHERE it can be done, the ship should be always put upon that tack that stems against the tide, when the anchor is let go; and if it is designed to continue at a single anchor, in order to keep it clear, I would recommend to sheer and keep the ship to leeward of the anchor, by keeping the helm a weather, and the fore-top-mast-stay-sail set with the sheet to windward, as represented by the ship figure 1, plate 4th. for the reasons which will be given, when treating on keeping a clear anchor.

GREAT advantages may attend letting go the anchor stemming against the tide; and especially where the tide runs very rapid, for it gives an opportunity to take notice at what rate the ship may be going a stern, so as to judge whether it may not be necessary to keep sail set, in order to bring the ship up, and ride easy in a rapid tide. I have been where we let go the small bower anchor, with all sails set, with a fresh breeze of wind against the tide, and veered out the whole cable, and the ship still drove; then we let go the best bower anchor and veered out all that cable, by which the ship brought up, and rode so close to a shoal a stern, that we were obliged to ride with the helm a port, to keep the ship with a broad sheer, to prevent her touching the ground, which would have overthrown the ship, broke away her masts, and turned her over, and over upon the shoal, and this would probably have been the case, had it not been for the sails being kept set, which helped to bring the ship up, and enabled her to ride against this very rapid tide.

To come to an Anchor at Slack-tide, or still Water where there is neither Tide or Current.

IT is expected in this case, that the sails are taken in, as the strength of the wind, and situation may require, to bring the ship up with ease; in moderate weather, and where there is room, it is certainly best to bring the ship to under the topsails, throwing her head up to the wind, by putting the helm a lee, with the topsails lowered down or clued up; and when the ship is perceived to get sternway, then let go the anchor to the ground, but veer out no

no more cable but as the ship takes it, by driving to leeward from the anchor, as represented by the ships, figure 2 and 3, plate the 5th, and not offer to bring the ship up, till it is thought that she has a sufficient scope of cable to ride her, on which it depends to snake the anchor and cable hold, as the occasion may require.

To come to an Anchor in Roads that are often crowded with SHIPS, so as to take and give good and clear Births.

THE best anchoring births in these places are commonly well known by marks, and the first ship naturally takes up, and has a right to keep one, clear from any other ship anchoring so near, as to make her a foul birth, as is represented by plate the 5th, where the ship figure 1, may be supposed to be come to an anchor, in the best birth, having the castle and windmill in one line, and the houses and church in another line of direction, pointing exactly to the anchor; these particulars ought to be wrote down in the log book, as should likewise the bearings by the compass, of extreme points of land, shoals, rocks, or sands, all which it may be necessary to remark, so that a course may be steered to keep clear of them, if the ship should be drove from her anchors in the night, or in thick weather, and that the anchors may be found again by the marks made when they were let go, if their buoys should disappear.

If it is a tide, or trade wind road-stead, the next ship that comes ought not to anchor right a head, or a stern, of the first ship, so as to lay in each others hause, but should come to on the bow and quarter, at a proper distance, to prevent other ships from coming between, and in a slanting direction from the tide or wind, as is represented by the ships, figure 2 and 3, plate the 5th. This in my opinion might contribute to the safety of ships in such places as the *Downs*, *Yarmouth Roads*, or the *West Indies*, and other such places, that may be crowded with ships; when it happens to blow strong upon a lee tide, or in strong sea breezes in the *West Indies*, each single ship may then veer away what cable may be thought necessary, and keep clear of the other ship's hause a stern, or in case of driving or casting, this gives a better chance to keep clear of each other.

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A FRIEND

ON BRINGING A SHIP TO AN ANCHOR.

A FRIEND told me that he often got a good anchoring birth in the *West India* road-steads, by first running down through the middle of the fleet, where he often perceived good births left vacant, by some ships that had sailed from the middle of the fleet: then he steered out from among the ships, and turned to windward of them all, so far as to give time to take in and furl all the sails, and run down before the wind amongst the ships, without any sail, and let go the anchor at the designed birth, which he could not have come at by any other means. The like practice may answer the same purpose at other times and places.

To come to an Anchor when designed to moor with the best and small Bower Anchors.

IN places exposed to waves, from one quarter more than another, and if the ship is to lie for some time, exposed to all the various winds that may blow, it should be made a rule to let go the first anchor, so that the ship may be moored with the second anchor, to lay with an open hause towards the sea, or the most open or worst part of the road, or river, where the greatest waves can come from, to give the ship violent pitching motions, which are always very destructive to the cables when riding hard with a crois in the hause, for which reason the crois in the cables should always be towards the smooth water quarter..

To let go all the Anchors to the best Advantage, when that is the only Chance left to keep the SHIP off a Lee Shore..

THIS desperate occasion happens when the anchoring ground lies less than two cables length from the lee shore, or when the ship is only that distance from it, with the wind and waves so high, right upon the shore, that it is found impossible for the ship to keep off the shore with all the sail she can carry; so that safety must depend entirely on the management of the ground tackle.

In such a dangerous situation, where, if one anchor or cable fail, there is not room to bring the ship up by another, (and it is counted a great disgrace to let a ship go on shore with any ground tackle

tackle on board, that might have been used to help to ride her,) therefore the utmost endeavours should be used to let go all the anchors, a little distance from each other, and as much as possible in a line along the shore, that one anchor may not hurt another cable, and that the cables lead clear of each other, and be made to bear a strain in proportion to their strength, to help to ride out the storm.

To put this difficult performance in practice, I would recommend to get the square-sails handed, with the quickest dispatch possible, but to keep the fore-top-mast, main, and mizen-stay-sails set, the yards braced full, and the helm put hard a weather, to keep headway upon the ship, shooting her along the shore, as much as possible, till all the anchors are let go, contriving to begin with the weathermost anchor, or that which has the cable in the weathermost haufe-hole, and so on with the next weathermost anchor, paying out the cables as fast as possible, that the ship may keep shooting a head till the anchors are all let go.

ON KEEPING A CLEAR ANCHOR.

IT is allowed to be a masterly and material branch of seamanship, to be able to manage a vessel riding in a tide way, by a single anchor, so as to keep it clear from the cable getting foul of the fluke, or stock, and sometimes foul of both fluke and stock, which may be the case; and the anchor thus being fouled, as it is termed, prevents its holding the ship, and may occasion her to drive on shore, or athwart another ship's haufe, which often happens from the want of proper methods being put in practice to keep the anchor clear: This therefore deserves the utmost regard, for in open roadsteads, when only waiting for a fair wind, it may be better and safer to ride by a single anchor, than to be moored when it blows hard, and among many ships, which are liable to drive athwart each others haufe, so that to save both ships, the leewardmost must be obliged to cut or slip; if riding by a single anchor, they have only one cable to get clear of, but, if moored with the two bowers, they have two cables to get clear of and that perhaps at a time when both ships and men may seem to be the sport of wind and waves, which may make one ship to rise whilst the other falls, and tear in pieces even our heart of oak,

and make our seamen's hearts of oak, which we boast ourselves so much upon, to fail, for what chance do feeble men stand, to fend off the blows one ship gives the other, at such times of distress, when nothing is heard but the crashing of timber, &c. and crying out for the leewardmost ship to cut, to relieve them, so that if moored, and she must part with both anchors, she may have only one anchor left to bring her up again, and ride by, and safety may still depend on keeping that clear; all which prove the great necessity of endeavouring, after fixed rules, to keep a single anchor clear.

To keep a clear Anchor, with the Wind right against the Tide.

IT should be a fixed rule on this occasion, at the tide first setting it windward, to shoot the ship a head of the anchor, to keep it clear, and not to offer to back her a stern of it, for that is found by experience to be impracticable, not only for the reasons given page 88, on a ship driving broadside, but because when the cable is lying upon the ground, the ship swinging with the tide, will bring the wind so much abaft the beam, that it will be impossible to back the ship a stern, clear of her anchor; yet I have seen this attempted in capital merchant's ships; and even in his Majesty's service I have seen some expose their ignorance in this important point of duty.

It should be another fixed rule, always to endeavour to shoot or sheer a ship on the same side of the anchor each tide, to avoid the risk of the anchor not turning in the ground, as the ship goes round it, as she will do when she is let go at random, on one side of the anchor one tide, and on the other side of it the next, by which bad practice the cable is liable to get foul of the upper fluke of the anchor that is above the ground.

THIS case I must refer back to the example page 94, where the ship figure 4, plate the 3d, is described to be managed according to the above rules, when she was brought to an anchor, and was shot a head of it on the starboard tack; so that when the windward tide makes again, she should be cast and shot a head of her anchor upon the same tack, as before represented figure 3, plate the 3d, until she swings to windward of the anchor, and comes to a proper sheer, with a tight cable growing on the larboard bow, and

and the wind on the starboard quarter, keeping her on this sheer with the helm a port; then the sails may be taken in, till the windward tide flacks, for there is no danger of a ship breaking her sheer, whilst the tide runs strong, in proportion to the wind that keeps her stern of the anchor; but when the tide flacks, or the wind becomes so strong, that the ship shoots end on upon the tide, a head of her anchor; then is the time she is liable to break her sheer against the helm, and requires assistance with sail, and the yards to be braced about, to prevent her from falling over her anchor, and fouling it.

BUT to cast the ship, figure 4, on the starboard tack, as above mentioned, when the lee tide is done, the head yards should be braced up sharp with the starboard braces, the after yards with the larboard braces, the fore-top-mast-stay-sail set with the starboard sheet hauled flat aft, and the helm hard aport; then the windward tide coming right aft, acts upon the larboard side of the rudder, in a direction such as will cant the ship's stern to starboard, and the wind at the same time acts upon the fore-top-mast-stay-sail, and the head yards, to cast her head to port upon the starboard tack. And suppose that, by the setting of the tide, or other accidents, contrary to your design, the ship should cast on the larboard tack, in that case, every thing is ready trimmed, as it should be, to ware her round on the other tack, the helm being aport, is now hard aweather, the head yards and fore-top-mast-stay-sail flat full, the after yards braced the other way, all act together, and will bring the ship round on the starboard tack, before she comes near her anchor; then the mizen may be hauled out, and the fore-top-mast-stay-sail, and head yards set drawing full, to shoot her a head, till the drives to windward of the anchor, with a tight cable as before described.

BUT to cast a ship the right way at an anchor, with a windward tide, is best represented plate the 5th, with a side view of the ship, figure 1, to cast her upon the larboard tack, when the lee tide flacks, the helm is put aport, to sheer the ship and bring the wind on the larboard bow, then set the spritsail and spritsail topsail, topped up to port, the jibb and fore-top-mast-stay-sail with the larboard sheets flat aft, and the jibb sheet under the spritsail-yard-arm to guy the sail further out to port, the head yards braced sharp up with the larboard braces, the after yards with the mizen-top-sail set braced sharp up the other way; strict notice should be taken when the lee tide is quite done, to put the helm hard-

ON KEEPING A CLEAR ANCHOR.

hard a starboard, so that the windward tide acting upon the starboard side of the rudder in that direction, and the wind upon the sails and yards makes them evidently tend to cast the ship the way designed, and when she is cast you have only to fill the head sails and yards, to shoot her a head with a tight cable, till the tide sets her to windward of the anchor, or swings her near end on the tide, and brings the wind on the larboard quarter; then the head sails should be taken in, and the head yards pointed to the wind with the larboard braces, and if she continues to ride a head of the anchor, which should be strictly noticed by the buoy, or the growing of the cable, more after-sail should be set, the mizen and mizen-stay-sail added to the mizen-top-sail, to help the starboard helm to keep the ship from breaking her sheer against the helm, and bringing the wind on the starboard quarter; when this happens with these sails set, the mizen and mizen-stay-sail must be immediately taken in, shiver or keep drawing full the right way the mizen-top-sail, set the jibb or fore-top-mast-stay-sail, the yards and helm being trimmed the right way, as before mentioned, to keep clear of the anchor, and bring the ship round on her proper sheer again, with the wind on the larboard quarter; then down headsails, and endeavour to keep her on this sheer, as before directed, till the windward tide is done.

On keeping a clear Anchor when the Wind blows a Point or two across the Tide.

IN this situation, when the tide makes to windward, it will naturally cast the ship with her head towards the weather side, and for the reasons before given, will swing her, to bring the wind so far abaft the beam, as to prevent backing her a stern of the anchor to keep it clear: therefore I would recommend to shoot her a head of the anchor to the weather side, till she comes to her proper sheer; the wind being on the quarter a little across the tide, will keep her from breaking her sheer, whilst the windward tide runs, and she may be easily shot a head on the same side of the anchor, again, as before described, when the windward tide is done.---But whenever the wind blows so far across the tide, that the ship can be sheered and kept to leeward of her anchor, I recommended

recommended this as much the best practice to keep a clear anchor.

To keep a clear Anchor, with the Wind right a-cross the Tide.

I STRONGLY recommend the simple and easy method of setting the fore-top-mast-stay-sail with the weather sheet flat aft, and the helm aweather, whereby the ship may be sheered, and kept near the same place to leeward clear of her anchor, both flood and ebb, as represented by the ship figure 2, plate the 4th. But this method of sheering a ship to leeward is quite contrary to that bad custom which is practiced in the coal trade, of sheering ships to windward of the anchor, and though I allow them to be the greatest proficients in managing ships in narrow and difficult channels, yet I hope to convince them that their practice in this instance is wrong. But Dame Custom, I know from experience, is a powerful adversary, and a great enemy to improvements, and will seldom submit to conviction; notwithstanding that, I shall endeavour to make a fair comparison, by describing both methods, as they are represented in plate the 4th, which was made for this purpose only, and then leave the merit of both to the determination of impartial judges. First, then let us suppose the wind to be off shore, and right a-cross the tide, as is represented plate the 4th, and that the ship figure 1, is commanded by Capt. Reason, and came to an anchor on the larboard tack, stemming against the tide, as described page 95, with her helm aweather, to sheer the ship to leeward of the anchor, which method not only keeps the ship clear of her anchor, but also makes her ride so near end on to the tide, with the wind rather abeam, that she may be helped with sail, to ride easier in a rapid tide; and when the tide is moderate, she will lie sheered right to leeward of her anchor, where she must be at each slack tide, as has been before observed. And if we suppose that she came to anchor at slack tide, as described page 95, she will then lie with the cable and anchor in the same direction, with the wind right a head; so that when either tide makes, so as to bring the wind upon the bow, they have only to hoist the fore-top-mast-stay-sail with the sheet to windward, and put the helm aweather, to keep the anchor clear, as you see represented by figure 1, plate the 4th.

Now

ON KEEPING A CLEAR ANCHOR.

Now we will suppose Dame Custom commanding the ship figure 3, in the same plate, comes to an anchor on the starboard tack, stemming against the tide, and puts the helm a lee, which sheers the ship, and lays her anchor in a slanting direction to windward, as represented by figure 3, till the tide begins to slack; then sets the mizen-top-sail aback, and in little wind, sometimes adds the main-top-sail aback, to back the ship a stern, clear of her anchor, according to her scope of cable, from her being near right to windward to right to leeward of her anchor, as represented from figure 3, to figure 2, where the ship must naturally lie in that situation every slack tide, with the wind and anchor right a head, till the other tide makes; then they shift the helm a lee, brace aback the mizen-top-sail and yards, &c. and sheer the ship nearly right to windward on the larboard tack, to complete almost the circle quite round her anchor every tide, as represented from figure 3, to figure 4, where it appears plain, the ship is made to take up above twice the room of the ship figure 1, consequently in that proportion her cable rubs over twice as much ground, is more liable to sweep foul of stones, wreck, or lost anchors, &c. which may greatly hurt it, and it may get under the upper fluke of her own anchor, if the anchor does not turn in the ground as the ship is sheered round it, which probably will be done at the last and first part of the tide, when it runs easy; when if the wind is moderate, and the bottom a tough clay, it is great chance but the anchor lies with the stock to windward, by the strain upon it in that direction, as above mentioned, and the cable may go over the stock when lying flat upon the ground, as the ship was backed to leeward of the anchor, and may sweep under the upper fluke as she is sheered to windward again, which makes it evident, that by this practice, Dame Custom is likely to ride with the cable foul of the upper fluke of the anchor, as represented figure 4. And to suppose the wind and tide so moderate, that the ship does not drive, yet the strain upon the upper fluke may cant it towards the ship, and raise the farther stock arm off the ground, by which in a clay bottom, the anchor may perhaps lie in that position, so that when the tide slacks, and the ship is backed from figure 4, to figure 2, it will clear the cable of the anchor fluke; and as they sheer to windward again, from figure 2 to figure 3, the cable is likely to sweep under the anchor stock arm, that lies canted off the ground. I defy the adherents of Dame Custom to account for their cables so often getting under
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the anchor stock, which naturally lies flat upon the ground, but from this bad practice.

AGAIN suppose Dame Custom comes to an anchor at slack tide, the anchor will naturally lie in the same direction with the ship and wind right a head; and when the tide makes, instead of keeping the ship to leeward, as represented figure 1, then the old Dame sheers and lies to windward of the anchor, as above mentioned; and suppose the wind to change, and come so far abeam that the ship cannot be backed a stern of her anchor, but shoots a head as the tide slacks, in this case, if it is good holding ground, we may reasonably suppose that the anchor has not turned in the ground as the ship has gone round it; the cable will then naturally sweep the upper fluke of the anchor, so that Dame Custom is likely to be adrift with the lee tide, if it blows fresh, or the tide runs strong, and may carry other ships adrift with her, which makes it dangerous for Reason to lie near Dame Custom, in crowded roadsteads, and it must make great confusion when one sheers their ship to leeward, and the other to windward of their anchor, they may sheer on board each other, which I have known to be the case, and Dame Custom has then abused Reason, by calling him lubber, for sheering the ship to leeward of her anchor, when Reason, who had observed their wrong proceedings, wagered in his own defence, that Dame Custom's anchor was then foul, which proved to be the case at heaving it up.

THERE is so much to be said against this bad custom, of sheering to windward of the anchor, that I am surprized how it came into practice, since nothing reasonable as appears to me, could be urged in favour of it; even in respect to work, to wear and tear, they all are greatly against it; so that I will advise every ship, commanded by Reason, to resort and lie together, as far from the adherents of Dame Custom as the room in the place will admit of; as they all sheer one way, to leeward of their anchors, they may lie with much more safety clear of each other, in less than half the compass of the ground that Dame Custom takes up, as is made evident by plate the 4th, which I hope will prove sufficient to condemn the practice.

It is but fair that we remark what effect the change of wind might have upon the ship figure 1, to leeward of her anchor, when it made Dame Custom foul her anchor by being to windward of it, as mentioned above. Suppose then that the wind comes four points abeam the beam; as long as the fore-top-mast-stay-sail,

ON MOORING SHIPS.

with the sheet to windward, will keep drawing the right way, and the helm is hard aweather, Reason, to leeward of his anchor will never come near to foul it; and to suppose by the force of the wind the ship ranges a head of the anchor, that she breaks her sheer, it will be with her head to leeward, clear of the anchor, till the tide drives her a stern of it again; so that whilst a ship by this method can be kept to leeward of her anchor, she should never be sheered to windward of it.

ON MOORING SHIPS.

RULES cannot be fixed to suit all places and all ships, but different methods may be necessary, according to the road, the size of the ship, her draft of water, and how she may be provided with ground tackle, &c. Where the tide runs very strong, and there is water enough, it is certainly best to moor water shot, the anchors and cables lying in the same direction with the tide, which can then have but little effect upon them, in comparison to what it has when a ship is moored across the tide, where the power of the tide alone upon the moorings, is of itself sometimes enough to bring the anchors home. Therefore great ships that have sheet anchors, and are well manned to clear the hause, when obliged to lie where the tide runs strong, moor with the best and small bower anchors, water shot; but small ships having only two bower anchors, and but few hands to clear the hause, drawing less water, may moor out of the strength of the tide, with the small bower and stream anchor, and hauser athwart the tide, and keep the best bower anchor in reserve, as occasion may require.

WHEN a ship is to be moored only to wait for a fair wind, the best anchor, and open hause, should be towards the foul wind quarter; but when a ship is to lie with all winds that may blow, the best anchor and open hause should be towards the worst wind that may blow, to raise the waves, and give the ship a pitching motion, as is mentioned page 98, and must leave no more of the smallest moorings within board, than just enough to freshen the hause on occasion; by which they will hold the longer, by having the longer scope, and the hause will be the easier cleared.

WHILE a ship is liable to ground with the ebb, and not to float till the flood tide runs strong, the safest method is to moore across

a-cross the tide, which lays the ship clear of getting damage upon her own anchors; when it requires to attend and slack the mooring, that her stern may swing over upon the flood, to prevent her girting. And when moored with a small anchor and haufer, the helm should be always shifted, to sheer her towards the small anchor, to ease the strain upon the small moorings; and to lay the principal stress upon the bower anchor and cable, to ride the ship when the tide runs strong.

I HAVE been mooring a ship in a very narrow river, where the shore on each side was nothing but loose shilly stones. We hid the bower anchor close over to one side of the river, and made fast a haufer with a long bowline knot, to the middle of a twelve feet deal board, on the opposite shore under the shilly stones, broadside, and its lower edge a little slanting, towards the ship, which held her better than an anchor would have done in its place. Another remark of this kind, which I think deserves notice, is what I have known done, where anchors placed one to back another could not be made to hold in sand:—a bulky bundle, made of ruthes that grow on sand hills, buried under the sand, and trampled upon, has held so that it would break a cable made fast to it; and no doubt but any thing of the same bulk would answer the same purpose.

ON KEEPING A CLEAR, OR OPEN HAUSE.

IN roads where ships are liable to be put in great motion by waves, which may make dangerous destruction of the moorings with a foul hause, the danger and trouble there is in clearing it, when the waves run high, make it highly necessary to endeavour to cause the ship to swing the right way each tide, to keep the hause clear, which the wind will do when it blows a-cross the tide, as may be supposed in plate the 5th, and that the wind was off the shore a-cross the tide, when the ship figure 1, was moored with an open hause towards the shore, to wait for a fair wind; whilst that wind continues, the ship will swing with her stern from the shore, and keep a clear hause without any trouble, but when the wind comes to blow right opposite to one tide, and in the same direction with the other tide running along the shore, as represented by the ship figure 1, plate the 5th, then it requires

management to make the ship swing with her stern from the shore, to keep the hause open on both tides. The method of proceeding the first part of the windward tide, when the wind is right a head, is fully described page 100, and to swing a ship the latter part of a windward tide, when the wind is right aft, requires only to put the helm over that way her stern is to go, as in this case to starboard, which will bring the wind on the larboard quarter; if it is little wind, the mizen, mizen-stay-sail, and mizen-top-sail braced up sharp, may be set, to assist the helm as the tide slacks, to swing her the right way to keep the hause clear, without the trouble of towing with a boat, running out a rope, and a small anchor, &c. which a calm, or the setting of the tide may sometimes require to be done.

On serving Cables to prevent their Chafing.

AS safety may often depend upon this, not only when the waves run high, but in smooth water where the tide runs strong, and by giving the moorings a trembling motion, may chafe them, therefore care should be taken to have them well served, not only in the way of the hause and cut-water, but so far as to reach below the gripe; for if a ship be moored water shot, or at a single anchor, with a windward tide, when it blows so fresh that she ranges about, and lies a head of her anchor, with a tight cable, the cable may be hurt under the bows and gripe, if not served low enough, with rounding and keckling. Therefore it is certainly best to have the cables properly served ready for mooring; as the time and place the ship is to lie in may require, as our *East India* ships in the passage home, when in a fine weather climate, put the proper service on their mooring cables; and in the coal trade to *London*, they put on their cables what they call a long and short service, to continue on for the summer's work.

THE best service that I know to preserve a cable from chafing in a storm, when the waves run high, is such as is used in the coal trade to *London*; it is cut from the best part of a tanned horse hide, big enough to wrap two or three times round the cable, which is readily and easily put on and taken off, and much better than the plats commonly used in merchant's ships, which are long and troublesome to pass, and beat about the cable; and after that are

How the small Moorings may be best applied in a Storm.

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are liable to become slack as the cable stretches, and rubs backward and forward in the hause; and when the ship pitches hard, it sometimes separates and makes openings between the parts of the plat, so that the cable may be chafed in these openings, which a leather service is not subject to, being all the length of the hide in one piece. The method of putting it on the cable, is first to wrap two or three fold of old canvas, the length of the leather service, which, if too stiff to put on dry, requires only dipping in water, and beating it against any wood, which makes it immediately soft and pliable; then let as many hands as can come at it, wrap it as tight as possible upon the old canvas, round the cable, tying it tight and smooth on with fennit, or three yarn nittles, made for that purpose, greasing them and the service, very well, before veering it into the hause-hole.

I WOULD advise to avoid a practice I have seen used on this occasion, that is taking a timber hitch with some nittles round the cable upon the canvas, then wrapping the leather service and the nittles round the cable together, which raises the leather in the place of those nittles where it will soon chafe through.

How the weakest Moorings may be best applied, to help a SHIP to ride out a Storm.

IN a dangerous situation, all practicable hints, that may contribute any thing towards safety, deserve notice; and it may often happen that the small bower cable may be too much worn, or the small moorings known to be too weak to bear the strain of the ship to ride out a storm, when the anchor at the best cable is in danger, or expected to come home; in this case, I would recommend endeavouring to make the weak moorings serve for a backing to the best anchor and cable, contriving a traveller (as it may be properly called) of sufficient rope, to go slack round the best cable, without the hause, and well secured with rolling hitches seized, &c. to the weak moorings that may be veered away, or let go as occasion may require; or if short of rope to make a proper traveller, a stopper may be put on without the hause, till the end of the small moorings is put round the best cable, with a bowline knot open enough that it may slide along the best cable, till it comes to the anchor stock, which may prove such a sure backing to

ON UNMOORING A SHIP.

to it, as to prevent its coming farther home; so that by this means, there is a much better chance to ride out a storm by the best cable, singly, than to run the risk of either anchor coming home, to bring them both a head together, by which one cable is apt to get foul of the other anchor, and to get so entangled as to make the anchors come home, or make it necessary to cut the cable which is foul of the anchor, if the ship has a pitching motion.

BUT it must be allowed, that this, as well as every other uncommon method, requires judgment to contrive, and resolution to put the design speedily in practice, as the occasion and necessity may require, to preserve the whole when safety depends upon riding out a storm.

ON UNMOORING A SHIP.

TH E R E needs little to be said on this subject, if the ship lies in a clear, roomy place, as either anchor may then be taken up first, by veering to it, or may be weighed with a boat, &c. But if situated among a crowd of ships, or near the shore, then it requires to look about, and consider well to take up that anchor first, that gives the clearest birth to cast the ship, or get her underway in the most advantageous manner, clear of the dangers that may be near. For want of conduct on such occasions, I have known great damage done.

IT was said by the celebrated Doctor Halley, that the System of Navigation in his time, depended upon three L's, meaning Lead, Latitude, and Look-out, each of which deserves particular notice, as safety, no doubt, will always greatly depend upon them. I shall therefore notice them in their order.

ON HEAVING THE HAND-LEAD.

THIS method of sounding the depth of water is peculiar to our seamen, and I judge had it's rise in the coasting trade to London, where their success and safety depended greatly upon it; and so dexterous, by their great practice they become, that they will heave the lead far enough to reach the bottom, and give true soundings

soundings in eleven or twelve fathom water, when the ship may be going at the rate of four or five knots through the water; and their rules being equal to their dexterity, deserve mentioning, and should in my opinion be followed as standard rules for the hand lead, for want of which being properly used, I have known many misfortunes and fatal losses, which might have been avoided. I have heard of a commander of a large ship, in the above coal trade, who in dangerous places always hove the lead himself, and cunned, or ordered the ship about, according to the soundings, which he sung, or spoke out aloud as the other men.

Rules commonly observed by a good Lead-Man.

WHEN ordered to the lead, he takes care, 1st. that the inward end of the line is made fast, to prevent losing it. 2d. That the lead and line may run clear, and come fair to hand, he takes them out before that shrowd next to his foremost hand where he stands to heave. 3d. The first cast of the lead he only heaves out about six or seven fathom of line, which prevents the lead being over hove, and readily makes known that the ship is not in immediate danger, when no ground is found at that depth; and it is an easy way to clear the line for a deeper cast the next heave, if the occasion requires it. 4th. When sounding in less than five fathom water, or when there happens a sudden alteration of less water, he heaves the lead as fast as possible, and speaks out the soundings briskly, with a loud voice, and does not sing them out, which takes so much time that I have known a ship to come a ground before the sounding was made known.

ON SINGING OUT THE SOUNDINGS.

THIS custom is certainly a benefit to a fleet of ships, sailing near together in difficult channels, where safety depends upon the lead, as in the coal trade to *London*, where I suppose the practice began, finding the advantage of hearing each others soundings as a guide to the whole.---Another advantage attending this practice, is, where a commander is not well acquainted, he *may*

may go off the deck, and look at the soundings laid down in the chart, or instructions for the place, and hearing the depth of water sung at the same time, compare how they agree.

But it must be allowed that there are risks attending this practice, by the lead's man standing still all the time he is singing out the soundings; for which reason the before mentioned 4th rule for a good lead's man, should be strictly observed, to avoid the danger there mentioned, to have happened whilst the lead's man was singing out the soundings, with a long tone, thus, *by, the, mark, thre, &c.* in which time the ship came a ground, which might have been avoided, had the soundings been spoke out quick, as above recommended. This makes me think, that it may be a disputed point, whether the soundings may not be as well or better heard, when spoke out quick with a loud voice, than when they are slowly sung out; if so, the advantage must be greatly in favour of speaking out the soundings, on all occasions.

ON SOUNDING WITH THE DEEP-SEA-LEAD.

I WOULD recommend, here, what I have found by experience to be an advantage, that is, having the lead only fifteen pounds weight, with a smaller line than common kept ready upon a reel, made large enough for the purpose, like a log reel, and hung up in beackets, where a man can readily take and hold it between his hands, on any sudden occasion: and that the lead may sink the faster, to have small and few marks, as the hand lead and line will get soundings at any time, in ten fathom water; the deep-sea-line need only to be marked from ten to seventeen fathom, as common, and from twenty upwards with knots as small as those in the log-line.

THIS lead requires various methods of heaving it, according to the depth of water expected, and the ship's head or lee way at the time the lead is to be hove. When a ship is sailing right an end, without much lee way, if soundings cannot be got by heaving it from the cat head, or spritsail yard, a man must carry the bight of the line to the jibboom end, and with a tight line swing the lead forward, when another man gives it all the force he can from the spritsail yard. This method well managed, will heave the lead the farthest

farthest it can be done, to get soundings, without bringing the ship to.

To bring a SHIP to, to Sound..

THE difficulty of getting true soundings, in a gale of wind, increases in proportion to the depth of water, and the violence of the wind and waves. The best method that I have experienced, is to pass the lead from the weather quarter, round the stern to leeward, without all, to the fore part of the quarter deck and a man to carry the bight of the line to the lee main-yard-arm, which is to be laid square when the helm is put a lee, to bring the ship to ; and when the ship begins to shoot to windward by her headway, then the lead is to be swung right to leeward from the deck, whilst the man at the yard-arm, with a tight line, swings it as far as possible to leeward of the ship, which gains to windward of the lead, whilst the headway continues, and then runs her stern up to the wind by the sternway, backs near to where the lead was hove, by which means, as mentioned in box-hauling, page 86, a great deal of line may be run out, nearly up and down ; and the lead being armed with tallow, makes it certain whether it has struck the bottom or no, and if it has, shews, what sort of a bottom there is.

WHEN and how oft it may be necessary to try for soundings, must be left to the discretion of the commanding officer, and will be more or less so, according to the nature of the coast, place, or situation of the ship ; but the want of it's being done in due time, is well known to have occasioned many fatal losses. Therefore they who neglect heaving the lead, will always be blamed in proportion to the degree of danger, and the loss their neglect may occasion.

TH E latitude when it can be got by a good observation, with a good instrument, must be allowed to be the only guide we have in navigation; because it not only gives to a certainty, the ship's place, North and South, but it likewise helps us to form a judgment how far a dependence may be put on our reckoning, East or West; in proportion as the latitude by the account kept of the ship's way, agrees or disagrees with the latitude observed in the passage in general; so more or less dependence accordingly may be put upon the longitude the ship is reckoned to be in.

On the Latitude of Places being wrong laid down.

WH E R E people are strangers to places which they have not got laid down from good authority, in new charts or books of established good character, but have them only in old books, or general charts on a small scale, where the latitudes may be very erroneous, great caution should be used to avoid the ill consequences which may attend such errors, when they may be drawing near to danger, or in making a land fall, &c.

I was in a ship bound from *Lisbon* to *Mazagan*, a Portuguese garrison on the coast of *South Barbary*, with which, in very fine weather and a fair wind, falling in as we thought by the latitude observed, we were in a fair way to find the place, the latitude of which we had only laid down in an old general chart, on a small scale. Being all of us strangers, we traced the coast close along shore by day, and laid the ship to at night; thus we searched for the place so long in vain, that we despaired of finding it, therefore it was resolved, if possible, to try to turn the ship to windward, against a current then running, and go to *Gibraltar* to get a pilot to find the place, when in our way back, we found it was a degree of latitude to the northward of where we had ever looked for it, owing to its being wrong laid down in the chart, and to our officers not getting every possible information, concerning a place with which we were not acquainted, before proceeding on the voyage.

BEFORE closing this subject, I cannot help acknowledging that great service done to all seafaring men by Mr. HADLEY, in the invention of his excellent Quadrant, for observing the latitude in

so easy and certain a manner, and which I can say from experience is most excellent, when compared to our old instruments, for that and the many other useful purposes it answers, in taking angles horizontally in surveying, and of the sun and moon, or moon and stars, towards finding the longitude, and equal altitudes to find true time, &c.

ON LOOKING-OUT.

A GOOD lookout may justly be said to contribute more than any thing towards safety, not only from shores or shoals, &c. but from ships running on board each other at sea, which no-doubt often has, and may prove fatal to those who neglect it. Therefore the utmost care should be taken, that this duty is not done in a careless manner; and the transgressors should be punished, by some means.

I was in a ship, in company with a fleet of ships of war, turning to windward in the night, with a fresh breeze of wind, when our mate of the watch, as walking the weather side of the quarter deck, was allarmed with hearing called out from another ship, "a good lookout before there," and an answer made by several "aye, aye,"--the mate ran to leeward, looked under the mainail, and saw a frigate on the other tack running on board of us; her jibboom ran within our lee mizen shrouds, and tore them all away; her sheet anchor fluke took our main chain plates, tore them all away, and ploughed away the plank and timbers till it got clear through our ships side, before one ship stopt the others way, and they were so locked and entangled together, that had it been a rough instead of a smooth sea, as it happened to be, one or both ships must have sunk, before they got clear of each other.

THIS shews, notwithstanding the strict discipline used on board our King's ships, that this important duty is negligently done there, as well as in other ships, by careless men, not considering how much depends upon their lookingout, when skulking or diverting themselves with stories upon the forecastle; they, without looking-out at all, will answer regularly to the word of command, "aye, aye," which occasioned the above misfortune. For these reasons, as long as the weather permits, the lookers-out stationed on deck, should be made to walk each man by himself,

which will prevent them from being diverted, or sleeping on this duty ; for it is well known that a man may stand and sleep, but he cannot walk and sleep ; and to make this duty both easy and well done, it should be taken spell and spell, according to the number of the watch that can be trusted, and as circumstances may require.

THE widest and clearest part of the ocean must be allowed to require a lookout ; for any two ships that are crossing each others track, may meet and destroy both ; and the worse weather, the more occasion there must be for caution. As I was crossing the western ocean, where we had a very narrow escape, sailing with a gale of wind, quartering under mainail and forefaisl, when the lookers-out upon the forecastle, seeing a light right a head, took it for, and said one to the other, it is a star, for which it passed till we came so near, before it was perceived to be a ship lying to with a light out, that we only just got clear of her stern, by putting our helm hard a port, which but just saved both ships from immediate destruction.

To prevent being deceived on this occasion, I think it necessary here to remark, that when any light appears in the horizon, or near the water's edge, it cannot be a star, for the atmosphere or air so obscures the stars, that they cannot be seen to rise or set in the horizon. When drawing near to any danger, where safety may depend entirely on a good lookout, if the weather permits, and the ship is manageable, and will work under her topsails, with the mainsail and forefaisl in the brails, it gives a fair opening for the officer, as well as others upon deck, to look round them, to see any dangers which may appear. The little difference thus made in the ship's sailing, is not to be compared with the advantage given for safety, or preventing damage on such occasions.

ON LOOKING-OUT FOR LAND.

IT is found to be necessary in foreign voyages, to propose a reward for the man that first sees and calls out land, if it proves to be really such ; and if it be not such, I think it is a bad custom to abuse him, if he happens to give a false alarm, by mistaking a cloud for land ; because it is well-known, that the land sometimes appears so much like a cloud, or a cloud so much like land, at a distance,

distance, or the land may be covered by a cloud, that often makes it difficult to distinguish one from the other. For which reason a man should not be made a sufferer for a mistake of this kind, but should be encouraged, and have liberty to call out from the mast head that there is something like land appears; this might prevent the bad consequences that sometimes happen, from people being afraid to speak in good time, for fear of being mistaken, and meeting with discouragement.

On Looking-out aloft for SHOALS, &c.

THIS duty well done, may prevent a ship coming aground; therefore the looker-out at the mast head, on this occasion, should be encouraged, and strongly recommended to make known without fear or reserve, all alterations or different appearances of the water; a seeming change of colour should not be omitted, though it may often proceed from the reflection of clouds, yet it may prove shoal water, and neglect may be fatal; for which reason an officer should always take the trouble to go up to look at what is noticed from the mast head, on all occasions; and ripples, broken water, or the appearing of an extraordinary smooth water, when the sea is rough, should all be strictly noticed, as they may prove to be great dangers.

By want of attending to this smoothness on the water, from the mast head, I had a very narrow escape from running the ship on shore, in turning to windward through the *Gulph of Florida*, when standing towards the *Colleradoes* with a design to make as bold with them as possible, in order to a longer stretch on the other tack. I ordered the man at the masthead to lookout sharp for broken water, which we expected to see at a sufficient distance; but instead of meeting with breakers, we fell into an extraordinary smooth water, all at once, which was taken no notice of from the masthead; we tacked in a great hurry, and had but four fathom water when the ship was got about, and was but just clear of the ground.

The sun
shining a
head hinders
 shoals be-
ing seen
that way. IN those seas where the water is very clear, and the weather fine, frequently from the masthead may be seen shoals that the ship might touch upon ; and especially if the sun shines a stern, or is abast the beam when the ship goes her course. This enlightens and makes more visible the parts of the shoals towards the ship, so that from the masthead, I had the experience of cunning a ship in the best of the deep, clear of dangerous shoals, through channels where we were not acquainted ; but a rough sea, or the sun happening to shine a head of the ship the way she is going, hinders the shoals being seen under water, though it may be clear and smooth. I had this last case confirmed, by an instance in lookingout for shoals, called the *Silver Key* or *Plate Rocks*, lying off the N. E. part of *Hippaniola* ; the sun happened to shine a head of the ship, when a part of the shoals we had passed were seen a stern, from the quarter deck, before any was seen from the mast-head. I was very angry with the man lookingout, till I was convinced he was not in fault ; for nothing could be seen under water a head, the way he was ordered to lookout, owing to the dark or shaded parts of the shoals being towards the ship, and the water reflecting the sun's rays upon the eyes of the looker out, that prevented us from seeing the dangers. I ordered the helm a weather, and brought the sun aft, and cunned the ship out again clear of the shoals, which we could see very plain with the sun a stern ; they seemed to be coral rocks, here and there one, in a straggling manner, with about four fathoms water upon them that we passed. But it must be allowed that these shoals, seen in an oblique direction, appear much shoaler than they really are, by the refraction of the waer being so much greater than that of the air ; as is well known from that common experiment of a shilling that cannot be seen obliquely over the edge of a bowl, till water is poured upon it, which caufes it to appear visibly higher to the sight. It is the same with these shoals, when obliged to go right over them, if the ship has water enough, they are seen and found by the lead to lie deeper than was expected.

IVENTURE, sailor like, to make some remarks on this fourth L, the discovery of which hath been long expected, and is still laudably pursued and encouraged by all the learned nations of the world.

THE great rewards offered, and the encouragement given by our government, has occasioned many methods to be tried for this useful discovery; Mr. IRWIN's Marine Chair, to observe by Jupiter's moons at sea, to which a fair trial has been given; Mr. HARRISON's famous Time Piece, which performed so well in the voyage of trial to the *West Indies*, as to gain £. 10,000 reward; and now what is recommended and published by order of the Board of Longitude, MAYER's Tables, and MASKALINE's Nautical Almanack, to observe and calculate by the sun, moon, and stars, which I doubt will require too nice observations, and too long calculations, to be performed without errors, by the generality of such seamen as at this time navigate ships at sea, who will think it too difficult to come near true time of day or night, on this uncertain element; and every minute they are out in that, makes an error of a quarter degree of longitude.

THEREFORE without this much laboured for discovery, can be brought within the reach of common capacities and learning to perform it with some certainty, without being liable to many errors, which every man is subject to in nice observations and long calculations among a multitude of figures, it may be productive of effects contrary to the design; especially by putting people off their guard, and giving too much confidence to the vain and positive part of men, who cannot bear to be thought wrong in their reckoning. Many instances I could give of this disposition, but shall only mention one, who, though he was steering an easterly course in the night, and was told that land was seen a head, replied, "that the devil must bring it there if there was any, which he could not believe."---The consequences of this obstinacy, was the loss of a fine large ship and a rich cargo.

THE Board of Longitude, in order to facilitate the discovery that is expected to be made by this last mentioned method, has ordered, that the masters for the royal navy must qualify themselves, by learning to pass an examination to shew that they understand the Nautical Almanack, which is a task, in my opinion, that cannot be expected from many of our most hardy and expert navigators, whose education has been mostly from early youth through the hard, laborious, and busy scenes of life at sea, and who have

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ON THE LONGITUDE AT SEA BY OBSERVATION.

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never had the opportunity, to get the learning that is necessary, to understand the true principles of this Almanack.

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On this occasion, with humble submission to the learned, I speak for myself and many masters of ships, who can conduct a ship to any part of the world, that hath its latitude and longitude right laid down, without having learned so much astronomy at school, as to understand the characters, signs and terms, &c. that are used in those Almanacks, to describe our system or set of worlds, with their moons and their motions round the sun; which terms, &c. are in an unknown tongue to one who is but a mere english reader: and our world and moon, with their motions and places, are there set forth in a complex mysterious manner, telling us every day where the sun is in the ecliptick, where no star is to be seen at that time, which makes us so little acquainted with the fixed stars, as to think that they and the sun, according to the old notion, go round us every day, as they appear to do by our world's daily motion. It is from our knowledge of the fixed stars, that lie near the moon's path, that the observations for his discovery are to be principally made, which shews the great necessity, not only on this account, but for many other benefits to seamen, for us to endeavour to get the course, motion, and place of our world and moon, described and represented in such a plain manner, that such navigators, as above mentioned, may form some notion how we and the other worlds, called planets, that belong to our system, are constantly changing places, each in their different orbits, or paths; and going faster or slower according to their distance, round the sun once in the year, in wonderful order, from the fixed stars in one part of the firmament, round to the same stars again, according to the laws given them by the Almighty Creator and conductor of the universe, as is illustrated, and in a particular masterly manner shewn in FERGUSON's Astronomy, where the names of the twelve signs in the Zodiac, and the rest of the constellations are in english, whereby the fixed stars are to be known. But the most fruithful imagination cannot find the least resemblance of those figures they are commonly called by, and which require a great while to learn; so that notwithstanding the pains taken by this extraordinary self-taught Philosopher, to whom I acknowledge myself under the greatest obligations, as what little I have learned in that science is from him,* yet I cannot help thinking, that this ancient

* The friendship MR. FERGUSON favoured the author with, and the advantages he derived from thence, call for every acknowledgment on his part; but to attempt to follow on that excellent

ancient method of teaching the motion of our system, is perplexing, and is a burden to the memory, for the reasons given above; and that it might be much better and easier taught to seamen, by the form of the card of the Mariner's compass.

It must be allowed that we excel the ancients greatly in ship-
ping, and navigating them, since time has discovered and brought
into use, that noble instrument the Mariner's compass, by which a
seaman knows how to steer a ship, and to calculate the ship's way.
He must understand how to quarter and divide this compass into
the 360 degrees, which, extended out in straight lines from the
sun's center, might represent the 360 degrees of the ecliptic, in
a much more familiar manner to seamen in general than the twelve
signs. Therefore to answer this good purpose, I would recom-
mend to those in power, to get a set of large plates engraved, such
as are used now to stamp handkerchiefs with; the first to repre-
sent our solar system as it really is, with the sun in the center and
its rays to form the tea compass card, with the 360 degrees ex-
tending outwards, through a large circle divided into the months
and days of our year; the North point pointing to the 21st of
December, which may properly be understood to be the norther-
most part of the world's orbit, as we then enter into what is now
the northermost constellation in the ecliptic, called Gemini, which
makes our shortest day, when at the same time the South latitudes
have their longest day; the reasons for it, and the other seasons of
our year will appear evident, by having our world delineated on
the eight capital points of this compass ecliptic, N. N.-W. W. S-
W. &c. round the sun, as Mr. FERGUSON has done in his 5th
plate of Astronomy, from which, and a scheme he drew for me
to make observations on the tides, I formed this design of what I
call the seamen's system, and had one drawn and put upon a wheel
work planitarian, to observe whether our neighbouring worlds

excellent and surprizing character, but a part of the praise justly due to him, greatly exceeds the writer's power. Mr. F. was really a self-taught, or rather heaven-taught, philosopher, who with no other advantages than half a year's common schooling, and during the pursuit of a me-
chanical profession necessary for the support of himself and family, acquired a degree of know-
ledge in astronomy and experimental Philosophy, which, his Sovereign, and the Royal Society,
un solicited, thought it but just to distinguish with rewards and honours.

After a life of useful labours, imbibed by domestic unhappiness, and a feeble and precarious
state of health, (to use the words of a friend of his here,) " worn out with study, age, and
infirmities, he was at length permitted to attain that heaven, on which his thoughts and
views had long been fix'd, and which is the ultimate reward of learning, virtue, patience,
and piety." *(See in Dodge's Ann. Register, 1776; Some account of the late celebrated Mr. Fer-
guson, by Dr. HoustoN.)*



passing

passing near us in their orbits, had any influence on the tides, but found none.

Thus by having our globe represented in different parts of the orbit which it moves in, at the rate of near one of the 360 degrees of the ecliptic every day, and in that time turns once round on the center of its daily motion, which is at the poles which lie in a direction of 23° degrees, inclinable towards the plane of its orbit, and the year round always keep pointing towards the same part of the starry firmament, as is evident to any common observer, who may see our North pole always points towards what we call the North pole star, that never goes below our horizon in North latitudes, by a little thinking, it may be perceived in general, how our nights and days with their alterations, and the sun's declination, are brought yearly about, by the sun always enlightning that half part of our globe that is turned directly towards it; and as it is on the 21st of December when our globe is on the North point of the ecliptic, when I would have the year for this system to begin, when the sun shines directly upon the South tropic, its light reaches 90 degrees round on our globe, takes in all the South polar circle where it is all day, by its then pointing most towards the sun: it is then all night in the North polar circle, because it points most from the sun, as represented in the figure on the North point of the ecliptic.

BUT comparing small things that can be seen, often helps us to form an idea of what is too big for our senses to discern; a bomb shell of twelve inches diameter, forced into motion through our air, may be seen by its fuse to keep turning round and round on its center of gravity, as it moves forward; so our globe, in round numbers about 8000 miles diameter, insensibly to us, moves forward in her orbit, as may be supposed, at the rate about 1000 miles in every minute of time, whilst it is known to keep regularly turning on the center of its poles a quarter degree of longitude, which makes fifteen degrees for every hour of time, that brings about midday and midnight to all the different parts of our globe, between the polar circles in twentyfour hours, as they are represented by the twentyfour meridians in the figures, which all center, or cross each other, at the poles, dividing our globe into the 360 degrees of longitude, East and West, as well as measuring the degrees of latitude, North and South.

THE

THE daily and yearly motions of our system of worlds, with their moons round them are all one way, that is from West Southerly about to East, and from East Northerly about to West again, what we seamen understand and call against the sun, or its apparent motion, as our globe is represented when it passes the North point of the ecliptic, and goes through our winter N. W. quarter, from N. to W. in its orbit, which brings our North polar circle more and more out of the dark into the light, and lessens the sun's South declination every day, till it comes to nothing on or about the 20th of March, when we are upon the West point of the ecliptic, and the center of our daily motion is then broadside to the sun, which shines right upon our equinoctial line, and reaching both poles makes equal day and night, to all the inhabitable part of the Globe, when the sun rises and sets on the true East and West points of the compass, without variation, and at the 6th hour in the morning and evening of that day.

WE then enter into our spring, and S-W. quarter of the ecliptic, and move forward every day as above mentioned, from the West to the South point of our orbit, as may be seen by the scheme how our North latitude days lengthen, and the sun's North declination increases to $23\frac{1}{2}$ degrees on or about the 21st of June, when the sun shines right upon the North tropic, and reaches over all our North polar circle, which then points most towards the sun, when the South polar circle points the most from it that it can do the year round, as represented by the figure on the South point of the ecliptic.

WE next go through our summer S. E. quarter of our orbit, from the South to the East point of the ecliptic on or about the 22d of September, when we are again broadside, in the center of our daily motion to the sun, which then shines directly upon our equinoctial line, and reaches both poles, rising and setting on the true East and West points of the compass, and at the 6th hour morning and evening, the same as when we are on the West point of the ecliptic on the 20th of March.

TO complete the year, we go through our fall or N-E. quarter of our orbit, from the East to the North point of the ecliptic, which every day brings the South pole more into the light for its half years day; and the North pole goes as much into the dark for its half years night, until the 21st of December, when we are upon the North point of the ecliptic again; and the sun having its greatest South declination, shines right upon the South tropic then

What occasions the half years day and night at the poles. At the begining of the four seasons, when we may see the sun and we bear true N. and S. E. and W. of each other by the compas.

Eight different places and faces of our moons and jupiter with his moons in minature to be added to the scheme.

The Almanacks to give our worlds place at midnight in the degrees of the compas ecliptic.

To try to observe Jupiter's moon at sea with Holland's

pointing $23\frac{1}{2}$ degrees towards the sun, when the North pole points as much from the sun, which is then true South from us, at noon by the compas as we are true North from it, which may be perceived by the meridian pointing right to it. And on the 20th of March, when we are on the West point of the ecliptic, the rising sun bears true East by the compas. And on the 21st of June, when we are on the South point of the ecliptic, our North pole then points $23\frac{1}{2}$ degrees towards the sun, which (from between the tropics) is, as it bears by the compas, true North from us, as may be observed by the noon meridian pointing straight to it. And on the 21st of September, when we are on the East point of the ecliptic, the setting sun then bears true West by the compas, from us, as we are true East from it. And these four compas quarters of our orbit, whereby our four seasons and quarters of the year are distinguished, contain 90 degrees of the compas ecliptic; which drawn out to the extent of a large handkerchief, will give room for all that is necessary to answer this purpose. Our moon with a different face in her orbit, may be put to each figure of our globe and Jupiter's moons, as Mr. FERGUSON has ingeniously done in his 5th plate of astronomy, might shew how they may be observed, going into and coming out of Jupiter's shadow, from our different meridians, in the different parts of our orbit. And without Saturn's orbit, may be placed the stars to the fourth magnitude of the twelve signs of the Zodiac, as the before mentioned necessary observations for the longitude are to be made.

By this scheme, and as the almanacks give the sun's place every day at noon, to shew our world's place at midnight, in degrees of the compas ecliptic, which in this scheme goes through the days of the month and which will point out very plain, what stars of the ecliptic will be brought upon, or nearest to the meridian every midnight in the year; we might soon become so far acquainted with them, as to know all the principal stars of the twelve signs, many of which are always visible in clear nights, where we navigate; so that on many important occasions, exclusive of the longitude, to know them as they appear would be of the greatest service to seamen, and more especially to the thinking part of navigators who never learned astronomy. They may hereby form a notion how we are situated and move, in our daily and yearly motions round the sun, conjectured to be from us the distance of about one hundred millions of miles, among the other worlds that belong to our system; and also how observations for the longitude

may

may be made by Jupiter's moons as above mentioned, to get the difference of time from Greenwich, as given in the almanacks allowing four minutes of time for every degree, which will give the longitude in East and West; and by comparing DOLLAND's improved spying glafs with the reflecting telescope. I cannot help thinking, that the weather may often permit these observations to be made at sea, with DOLLAND's best glasses, which certainly deserve a fair trial, as it is well known, some officers are by practice so expert with them, that they can stand upon their sea-legs, as it is called, and balance themselves in a surprizing manner, so as, in some measure to counter-act the ship's waving motion, when they are using the spying glafs, or taking obseruations so that by practice it is to be hoped, these obseruations will become of great use, at least in smooth water. And as we pass Jupiter in his orbit, once nearly every year, it should be noticed, as represented in the scheme, that when we are coming up with Jupiter, to observe his moons going into his shadow, and when we have past him, to observe them coming out of it; and that their motion round him is the same as our moon round us, against the sun, from the right hand to the left.

I WOULD further recommend to those in power, to have two more large plates engraved and made public, with the West and East hemispheres of the fixed stars, as represented on the best celestial globes; the first plate to begin and continue the degrees of the equator and the ecliptic, according to the yearly course of our globe, from our winter to our summer solstice; and the second plate from our summer to our winter solstice again, and to have the days of the year added to the degrees of the equator; the meridians of which will point out our situation, to know what principal stars will be visible, and come upon, or near the meridian, every midnight in the year; and to have them named, marked, or numbered, so as to be better known to an english reader, than by the hard names and characters they now bear. And as the equator crosses the ecliptic that extends to the opposite sides of the North and South tropicks, and the poles of the ecliptic to the opposite sides of the polar circles in each of these spheres, it would shew by inspection, from the days of the month at the equator, the declination of the stars, that lie in the plain of the ecliptic the year round, occasioned by the obliquity of our world's motion to the plain of the ecliptic, as before mentioned.

To have
two large
star hemi-
spheres
made
public.

I AM

I AM so well persuaded that these three schemes thus made public on handkerchiefs, executed by masterly hands would be frequently of essential service to many seafaring men, who without any advantages of education or any considerable previous knowledge of the subject, are given to observation and desirous of information, that I got them all drawn by a self-taught philosopher, but I reckon them so inferior in comparison with such as the board of Longitude, for instance, could point out and get executed, (and that at no great expence,) that I complied with the opinion of my friends in not adding them to this volume, the price of which they must have enhanced, nor would they have been within the compass of every body's pocket, nor have fallen into nearly as many hands as the proposed handkerchiefs, which, if common amongst seamen, in my opinion, would induce the inquisitive part of them, who are so much on duty upon deck in the night, to employ their vacant time in comparing these representations, and what has been said on the occasion, to what may be observed and learned from the grand system of created nature, and the general laws given to our sun's system of world's; and contribute to make them, and the principal fixed stars more easily and generally known by inspections; that uninformed people, by land as well as by sea, might learn often to find guides in clear weather, when at a loss to find their way in distressed situations; especially seamen, when by accident, or misfortune, deprived of the compass, at a great distance from a land of safety, which they may be forced to attempt to reach in small boats;--as well as many pilots and fishermen, who go to sea in such small boats, that a sea compass will not stand steady enough to point out the course they intended to return by, when driven of their coast by storms.

Such a general knowledge as might be derived from hence almost by any seaman who can read, might frequently prove of the most beneficial consequence in causal situations of distress, like those just mentioned, which are sufficient often to discompose even learned men, and to deprive them for a time of the use of their abilities and presence of mind. But in order to remove the difficulty to ignorant people, arising from the hard greek names given to the stars and constellations, it would certainly be serviceable to add to some of the more considerable and material of them, a familiar name by which they might be known, and which might bear some relation, or resemblance, to the apparent figure of them. Thus for example, instead of calling those which point to the

North

North Pole star, the Great Bear, of which no form or likeness whatever can be traced, I would call them the Plough, to which I think they bear a much greater resemblance, therefore they may be much better, known to point out the North Pole star, which lies near in a straight direction with the poles which our world turns upon in its daily motion, and where all our true meridian lines meet in a point, which makes the plough pointers, as I call them, whenever they appear plain above, below, or oblique always to point to it; and in coming home from India I have observed the plough, when above the Pole star, with great pleasure in upwards of twenty degrees south latitude, and when we came to four degrees north latitude in clear nights, the north pole star appears about four degrees above the horizon, which makes these stars the most extensive and advantageous guides on distressed occasions of this kind; for it may be easily conceived in clear nights when these stars can be seen, how to get either by sailing or rowing on, or near any of the eight capital points of the compass without variation, for keeping the pole star, or its place, same right a head, or a stern, goes true N. and S. and on the larboard and starboard beam E. and W. and each of these blows N-E. and N-W. and each of these quarters S-E. and S-W. And as the stars of the ecliptic, in clear nights, may be seen to the whole extent of the inhabited parts of the world, if familiar names were given to them (such as the yard wand for Orion's belt,) and the midnight marked down on which they were to pass near the meridian, that the moon, with their rising and setting, would certainly afford great help by night, and the glorious luminary, the Sun, by day, when it can be seen, needs not to be mentioned, which, no doubt, were all the guides that the famous ancients travelled and navigated by before the wonderful beneficial instrument the sea compass was discovered.

I SHALL just remark before I conclude this subject of finding the way, when deprived of the inestimable providential advantages of the sea compass, that, when likely, by cloudy and thick weather, to lose sight of the Sun, Moon and Stars, as was the case for fourteen days in St. Paul's voyage to Rome, and having no other view of a guide, to observe upon what part of the body, or of the vessel the wind blows, and it may be kept upon the same point; but when it is thought to be altered, and it is not known how much, and to what point, then, if it can be done with safety, it is but prudent to stop, or lie to till some guide can be discovered.

THE

THE late discovery of a new Planet, to which, (in honour of our most gracious Sovereign, who has eminently distinguished himself by his attention to improve nautical and astronomical science,) the name of the Georgium Sidus has been given, by our great Astronomer Mr. Herschel, who hath brought to our knowledge another world belonging to our System, which, no doubt, like our other worlds, is wonderfully constructed, and mysteriously conducted and kept in exact order; each of them revolving regularly in their hourly, daily, and yearly motions, with their necessary moons attending them, in their different and vastly distant elliptical orbits, clear of each other, round our sun; which motions produce days, nights, and different seasons, as before observed, for the production in the vegetable and animal creation, of those admirable properties, which we experience in this our world, for the benefit of the multitude of inhabitants, thereof, and principally for the support, use, and convenience of man.

“ These Works are all of matchless Fame,
 “ And universal Glory claim ;
 “ By those who seek for them aright,
 “ And in the pious Search delight ;
 “ And to posterity record,
 “ That Good and Gracious is our LORD.

IT appears not improbable, but that the knowledge of the new discoveries, and the extension of nautical science, may be much promoted, by the various late institutions for that purpose, as the Marine School at Chelsea, &c. and the plan proposed, (if duly carried into execution,) of having on board each of our channel cruisers, an old officer, employed to act as a school-master, and promote the information of the young persons on board, desirous of being instructed experimentally in the nature of a profession, in which knowledge and assiduity give dexterity and excellence, and in which, their duty, their interest, their honour, and their safety, should at once induce them to endeavour to excel.

BUT I think nothing would contribute so much to this important purpose, as having Maritime Schools in proper places at our sea ports, where the most dexterous, real Practical Seamanship is required, and may be easily seen in narrow waters, by the scholars who are designed for sea officers and pilots, which I have been long in pursuit of, and shall endeavour to describe hereafter.

F R O M

FROM all that I have seen, the seamen in the *East India* trade are the most perfect in the open seas, and those in the coal trade to *London* the most perfect in difficult narrow channels, and tide ways, where, as they sail by the voyage, it makes it their interest to be as dexterous and expeditious as possible in working and managing their ships, which in general are of 400, or 500 tons. This trade is hence rendered the best nursery in the world for hardy, active, and expert seamen, and as most ships must be conducted through channels, or narrow waters, in their way to sea, I will endeavour to remark what I think deserves notice in making passages in the coal trade.

ON MAKING PASSAGES IN THE COAL TRADE.

IN the navigation from *Newcastle* to *London*, two thirds of the way is amongst dangerous shoals, and intricate channels, (as may be seen by the chart of the coast,) and the ships are as large as the shoal channels will admit them to get through with the flow of the tide, which requires to be known to a great exactness to proceed in proper time, and dexterous pilots to navigate through those channels with safety and expedition, to make so many voyages in the year, that they may be gainers by their ships, which are numerous as well as large, and managed by the fewest men and in a more compleat manner than in any other trade that I know of in the world, considering the difficulty of the navigation, and how deep the ships are loaded, and how lightly they are ballasted, yet they meet with very few losses in proportion to the number of ships, which the owners generally run the risque of, and thereby save the expence of insurance, by which means they can afford to freight their ships cheaper than others, so that they are become the chief carriers in the timber, iron, hemp, and flax trades.

BLOWING weather and contrary winds, often collect a great many of these colliers together, so that they sail in great fleets, striving with the utmost dexterity, diligence and care, against each other, to get first to market with their coals, or for their turn to load at *Newcastle*, where at the first of a Westerly wind, after a long Easterly one, there are sometimes 200 or 300 ships turning to windward in, and sailing out of that harbour in one tide. The

sight of so many ships, passing and crossing each other in so little time and room, by their dexterous management, is said to have made a travelling French Gentleman of rank, to hold up his hands and exclaim, "that it was there France was conquered;" the entrance into the harbour being very narrow, with dangerous rocks on one side, and a steep sand bank on the other, with a hard shoal bar a-cross, where the waves of the sea frequently run very high, and put them under the necessity of being very brisk and dexterous.

THEIR management is most worthy remarking here; when they are going out with a fair wind in their great deep loaded ships, and the waves running high upon the bar, so that they would make the ship to strike upon it, if she was to sail out, pitching against the head waves, to prevent which when they come to the bar, they in a very masterly manner bring the ship to, and she drives over, rolling broad side to the waves, which preserves her from striking.

I HAVE heard of a bold single adventurer getting to sea out of this harbour, when many ships lay windbound with the wind and waves right in, and right upon the shore without the harbour; he having a small handy ship, and no doubt, materials and men that could be depended upon, made every thing snug and ready, as the occasion required, and got as near the bar as he could ride with safety, and had the sails, that were designed to be carried, furled with rope yarns that would easily break; he then took the advantage as may be supposed, of the first of the ebb of a high strong spring tide when there was water enough, and so drove over the bar, stern foremost, with the sails all furled and the yards braced sharp up, (as mentioned page 88,) by the strength of the tide out of the harbour, 'till they reached the sea tide from the southward along the coast, then put the helm hard a starboard, and brought the ship by the wind on the larboard tack, and expeditiously set all the sails they could carry; the tide checking the ship two points on the lee bow, helped her to get to windward off the lee shore, so that they made their course good along the coast, and got their passage.

WHEN it happens that a great fleet of loaded ships sails out in one tide, with the first of a westerly wind, those that draw the least water take the advantage and get over the bar first to sea, where they strive and carry all the sail possible to get and keep a head of each other, and the fastest sailing and best managed ships commonly get the advantage whilst they are in the open and clear part

A ship
got to sea
by driv-
ing stern
foremost
with the
tide.

part of the sea, till they come to work out of *Yarmouth roads*, where for want of water the ships of the greatest draft are often obliged to stay for the flowing of the tide, and each ship is glad to follow another, which they know draws more water than themselves when going through dangerous channels; this collects many of them near together again for their mutual safety, each heaves the lead and makes known aloud the soundings which often proves the principal guide to the whole fleet, as by that they find and keep the best of the deep in the intricate channels they pass through and in which they often have a great deal of turning to windward against strong westerly winds. When they are obliged to stop the lee tide, they do it with the best bower anchor and cable to the better end, which makes them so expert in heaving up their anchors, and getting underway, as well as working their ships to windward (as particularly described page 83) and especially up the *Swin* channel, in weather in which they would not venture to proceed with a fair wind. This seems a paradox to many people, therefore it may be of service to explain their singular conduct on this occasion.

WHEN they turn to windward up the *Swin* in dark hazy weather, they know by their soundings when they are in a fair way, and what side of the channel they are on, and by standing quite a cross the main channel from side to side avoid the danger of being hooked in, on the wrong side of spits of sand in swatches where the tide runs through, and where there is the same soundings at the entrance as in the right channel, which is the reason that with a fair wind and hazy weather, a compass course is not to be relied upon, therefore each ship, very artfully, endeavours to get a leader that they know draws more water than themselves, and the leading ship knowing their danger running no farther than they think it safe, commonly lets go her anchor, the next following ship apprehending the same danger, has her anchor ready and lets it go just above the first ship, and the next steers close past these two ships and comes to an anchor just above them, and so on with the next, till the whole fleet forms a line one above the other, so that the ship that was first, becomes last, when they commonly again heave up her anchor, and steer close by the whole fleet if they are perceived to ride a float and the next ship follows them, and either comes to an anchor again above the uppermost ship as before or proceeds forward, according as they find by the soundings, by which they know that they have past the dangers they

Why they choose a turn, wind, rather than a fair one for safety.

How they steer by one another in hazy weather.

were afraid of and got into a safe track, where they can depend upon the compass course, then they set and carry all the sail possible to get or keep a head of each other.

Their dexterous management in London river.

THEIR management in working these large ships to windward, up most parts of *London* river with their mainsails set, is likewise remarkable, and, from their great practice, knowing the depth of water according to the time of tide, and how much the ship will shoot a head in stays, they stand upon each tack to the greatest nicety close from side to side as far as possible things will admit of to keep in a fair way, and where eddies occasion the true tide to run very narrow, or ships, &c. lie in the way so as not to give room to turn to windward, they very dexterously brail up main-sail and fore-sail, and drive to windward with the tide under their topsails by such rules as have been described; and in the pool where there is so little room to pass through such crowds of ships, their management has afforded me the greatest pleasure, to see when they get near their designed birth, to what a nicety they let go their anchor, veer out the cable to run freely as occasion may require, so as to bring the ship up exactly in time, in surprizing little room, clear of the other ships, and lay her easily and fairly along side of the tier of ships where they moor, so that, as they say, they can work and lay their ships to a boats length occasionally. And there is no doubt but that to shorten the voyage, by which the men are paid, occasions this extraordinary industry, and dexterous management, every man for his own interest here exerting himself, encouraging and striving to get before and excel each other, in doing the necessary duty. When it happens that the ships come a ground, they readily first carry out a catch anchor and towline, and if that is insufficient, they haul out a bower anchor by it, to heave the ship off. In heaving up their anchors briskly with a windlass they greatly excel other merchant ships; but the difference of men as well as things, can only be known by comparison. I had a ship in the merchant's service, that hove with nine handspikes double man'd at the windlass, to heave up the small bower anchor, which we found so difficult and took up so much time, that to avoid the risque we ran, in getting the ship under way in narrow waters, I was going to have this anchor changed for a less, till at *London*, I happened to employ a mate and seven men from a Collier to transport the ship to the Graving Dock at *Deptford*, when these seven men, only, hove up this anchor by two brisk motions, for each square of

Difference of men in heaving up an anchor.

of the windlass in a quarter of the time that it used to be done by eighteen men, and this difference was entirely owing to their dexterity, learned by great practice; they rise with their handspikes, and heave exactly all together with a regular brisk motion, which unites their powers into one. And they are equally brisk and clever in warping, or transporting a ship with ropes, and likewise in handing, reefing, steering, &c.

ON THE IMPROVEMENTS OF THE WINDLASS.

SINCE my mentioning in the first edition the great difference of men employed in heaving at the windlass, which is certainly much the best machine to work the ground tackle for ships that carry few hands, there have been two Patents got for the improvement of it. The first by Mr. *Stephen Wright*, of North Shields, a ship master in the coal trade to London, which deservedly continues in general practice, owing to the great advantages attending it, not only by the friction being greatly lessened, by its turning on an iron axis, but by its having iron palls at the windlass bits, added to those amidships, made to stop at every sixteenth square, instead of every eighth, by which latter practice the people were often much hurt. And it proved its advantages, in company with a fleet of ships at anchor; for he was enabled to heave his ship a head against a strong wind and waves, and hove up his anchor with safety to his people, and left the others all behind where they were obliged to lay for more moderate weather to get their anchors, by which he got his Patent, and very justly supported it, when repeatedly tried at law, and I think deserves the thanks of the public for this very great improvement of the windlass.

THE other Patent was got by Mr. *Moor*, a great Mechanician in London and called *Moor's Balance Palls*, which had a great run in practice for a time, and was usually fixed to the end of *Wright's* windlass, then commonly called the double Patent windlass. But it hove with a long bar, that made it very heavy to lift up, and its power was so great, when they hove a strain, that it bent and spoiled the iron axis of *Wright's* windlass, so that it was soon out of practice. But though it failed in this design for ships, I think it did great credit to *Moor's* mechanical genius, for, what I imagine was its first design; a tradle to give motion to a wheel carriage.

I cannot

I cannot help thinking, on this occasion, that, if experiments were tried, a greater additional power than Mr. *Moor's* balance palls, and which would work much easier, might be applied with great advantage to the body of *Wright's* windlass, without any danger of hurting it. And this might be of great service not only in ships that are obliged to carry large boats or lumber, so near their windlass as hinder their heaving with bars in the holes near the midships but at all times and on all occasions when either quick heaving or a great strain is required, which in my opinion would make it of great importance to shipping.

BUT the real advantages that attend improvements of this kind, cannot be known but by making fair comparisons from experience. In the year 1750, I was concerned with that worthy Hero, Cap. *Fortunatus Wright*, in purchasing and fitting out the LEOSTOFF, 20 gun frigate of war, with a long windlass that hove with common bars; as mentioned page 132.

THE method then of making a windlass, was of one large piece of timber; which increased its price; and the longer it must be, and more bar holes which it must have for large ships, made it the weaker to bear a great strain, heaving no palls at the windlass bitts, but only those amidships, which only stopped at every eighth square. So that in good holding ground in roadsteads, when heaving a peak to weigh the anchor when the waves run high and the palls are near but could not be hove down, the quick rise of the ship, by the swelling waves, has sometimes hove the men over the bows; and such a great strain is brought upon these common long windlasses, as to break them; and by which we had our windlasses broke, which put us to great difficulties in purchasing our anchors with the capstan, with the few hands we could afford to carry.

THESE great defects certainly prove the vast and important advantages of *Wright's* windlass, to preserve the people from harm, when heaving up an anchor at such times as last mentioned. Even with his improved windlass, he told me the cautious method he took, which I think deserves notice here; which was; when hove to a long peak by the windlass till a great strain is felt upon it by the ship's quick rising with the waves, then to leave off heaving with the bars at the windlass, and hove the windlass round with a brisk motion by a single rope gigger at the capstan, as the cable slackened by the fall of the ship's bows in the hollow of the sea; so that they had only to hold on the cable with the capstan till

till the great strain was over by the rise of the waves, which weighed the anchor, and then the people left the capstan and hove the anchor up with safety at the windlass, which I think does great credit both to his conduct and his windlass.

ON IMPROVEMENTS OF THE WINDLAS BARS.

ALL that I aim at on this occasion, is to propose bars to increase the power of this excellent windlass, without being liable to hurt it as before mentioned. And that I propose for this purpose, is to have long straight bars, twelve or more feet long, according to the height of the windlass, and made about three or four inches square, (the breadth of the windlass bitts) to be tapered away, round to each end, the same as a common bar, and worked on the body of the windlass, either on what is called the ragged wheels for the iron palls at the inside of the windlass bitts, or on the eighth square of the windlass between them and the pall bitts amid-ships.

THE bars that are to be made to heave by the two ragged wheels; and when the square and all the palls are properly down, the middle of the bar is to be laid on the windlass, close to the bitts, right above the top tooth of the ragged wheel, with the fore end down to the deck; then form a mould for a curvid iron claw to be fixed about the fore square part of the bar, that the claw may just reach and hook the fifth tooth from the top one at the fore part of the windlass; and another mould for what I call an iron step, fixed on the bar just to reach the upper part of the second tooth from the top one of the ragged wheel on the after part of the windlass, so that the after end of the bar will be just so high that a man may reach it from the deck, which position, with the length of the bars, will certainly give men, heaving at them, very extraordinary advantages over the common bars to increase the power of the windlass.

For it is well known that working men in general, by their wonderful muscular strength, can lift twice their own weight; and many strong men a great deal more; so that a man at the fore end of these bars near the deck, when a great strain is required, may heave or lift upwards twice his own weight, or more

more in proportion to his strength; and a man at the after end of the bar can heave downwards *wbolly* his own weight, at the same time, when, men standing *upright* at the top of the windlass with the common bars, cannot heave *half* their weight; and from the length and strength of these long bars (that may be double manned) I reckon the power of the windlass may be above trebled by them; and our *East India* ships might work their ground tackle by them on their flush decks, which would certainly be a great advantage to them.

BUT it must be allowed, that these long bars can only heave one eight square of the windlass at a time; yet as they can be so much more readily and easily shifted than common bars can be unshipped and shipped again to heave, and their length and weight being so equally poised upon the windlass, in my opinion, they will afford so many great advantages to shipping, as to contribute greatly to safety and success in proceeding, by being enabled, not only to heave a head and purchase heavier anchors than are commonly used to ride by, but to heave them close up much sooner after they are a weigh, by quick heaving: for want of which improvement many ships get on shore, or on board other ships in getting them under way where there is little room; which has been my case, as has been noticed; for a ship is not under command of the helm, either to ware, stay, or even to steer, while the anchor is much below the bows.

THESE important reasons made me very desirous to get a fair trial in practice. Having thought of different methods, I got an opportunity, and begun with my first thought, to get one made to heave on the ragged wheels on the body of *Wright's* windlass, as above mentioned; but the ship failed before it was compleated; when all who saw it, allowed it was very promising to answer its designed purpose.

In making this bar to heave upon the ragged wheel, I thought of another method to make it upon a more easy and simple construction, that would heave with equal power as the last mentioned on *any* windlass, the common as well as *Wright's*, where the eight square is retained near the bits in the form they are made; but no opportunity offered to get it tried in practice. I got a model of a windlass made with four common bars in proportional dimensions; two to heave at each end of the windleſs; for I would not have these long proposed bars to heave the end of *Wright's* windlass, which would spoil its iron axis by their great power, as has been mentioned;

mentioned ; but they may be used at the ends of the common windlafs without any danger of hurting it ; and on trial they answer so well in heaving the model of the windlafs above mentioned, that I doubt not of their answering the important proposed purposes which I have endeavoured to describe, if they had a fair trial in practice, by sea officers of a mechanical turn that love improvements, without which they cannot be got forward.

BUT that people may judge for themselves by a fair comparison, I got a copper-plate engraved, representing men heaving a great strain at the windlafs, with the common and proposed improved bars, with the cable leading towards the haufe hole, as represented at the bottom of plate the 5th; by which I hope their advantages will be perceived, and how easily they may be made, to try the experiment in practice.

THE one that I got made to heave upon the ragged wheels of *Wright's* windlafs, as before described, was sawn from strait grained, three inch *New England* plank ; which seemed to answer the purpose very well. But to make these bars to heave upon the eight squares of *Wright's* windlafs, as represented in the plate ; the ragged wheels and their iron palls should be sunk in the windlafs bits ; and where there is room, two more may be made to heave close to the pall bits, where the windlafs retains the true eight squares, as they ought to be made true to do for this purpose ; so that when four of these long bars, double manned, can heave on the body of *Wright's* windlafs, it need not be made so long as it must necessarily be to heave with common bars ; and the shorter a windlafs is, and the less holes cut in it for the common bars, the stronger it is to bear the great stress and strain of large heavy ships, which, by this method of heaving, the body of *Wright's* windlafs needs to be made no longer than just to give room enough to work the cables, without any holes for the common bars to weaken it ; by which means, in large ships, the necessity of having cumbersome bits abaft the windlafs to prevent its breaking, may be avoided.

IN making these *Bars*, I would recommend first to make a mould for the bar, of a piece of sheathing board, as represented plate the 5th ; fig. 1, the middle of it made to say to the top eighth square and the next square before it of the windlafs. When the palls are all down, the *fore end* of the bar must flant down, near to the deck ; and the after end rise so high, that a man can just reach it fairly from the deck ; and by this mould the

PROPOSED IMPROVEMENTS OF THE WINDLASS BARS.

bar may be made, sawed from straight grained, three inch planks, as before mentioned.

BUT the square of the *Bars*, must be made to press and bear entirely upon the after corner of the upper square of the windlass, but to cut and leave about half an inch play towards the fore corner of the upper square of the windlass, as represented plate the 5th; that when the square is hove down, it gives room and admits the bars to turn easily forward to fetch and lock again for the next square, &c.

THE *Claw* is to be made to fit and be adapted to the other fore squares, and one half of the under one, of the windlass. The *claw* must be made of a flat iron bar, about three inches broad and half an inch thick, doubled, leaving a space in the doubling equal to the breadth of the windlass bar, to which the open ends of the iron bar (which now makes the *claw*) must be fastened with wood screws.---To prevent the narrow edges of the *claw* from chafing the squares of the windlass, the space or hollow of the *claw* may be filled up with fir, fastened with small wood screws.

EXPLANATION of the PLATE.

Fig. 1. Represents the Bar.

Fig. 2. Represents the Claw.

Fig. 3. Is the Bar with its Claw fitted to the windlass.---A is the *fore* end of the Bar slanting down near the deck.---B. the *after* end of the Bar, rising so high that a man can just reach it fairly from the deck.---*a a a a* the Claw as fastened to the Bar, and fixed to act upon the body of the windlass C----D the cable leading towards the Hause Hole.

IF the ship in her way to sea, requires a qualified Pilot, who is liable to be called to an account for any misfortune, it is but reasonable that he should be obeyed, and consulted by the ship's officers, and that they should see that all things necessary, both men, and materials, be ready to proceed in proper time, otherwise the Pilot may justly refuse to take charge of the ship; from the want of these necessary preparations I have known many bad accidents happen.

THESE ships in general, I can say from experience, compared with the colliers just mentioned, are under great disadvantages in the dexterity of their men to work and manage them, in narrow channels and tide-ways, their crews in common being a mixture of good and bad seamen, and in heaving up their anchors with a windlass, the efforts of the good men are lost among the bad, who for want of practice or a willing mind, do not keep time to heave altogether with the good men, but heave in a lubberly manner one after another, which occasions the great difference mentioned in heaving up that anchor, which seven men performed, much better than eighteen whose strength was so divided. Sailing by the month instead of by the voyage, makes the lazy bad part of a ship's crew more backward in doing their duty, as being no ways interested to expedite the voyage.

If the channels are narrow, with swatches joining them, that occasion cross tides amongst shoals that are under water, all possible pains should be taken to get two objects for leading marks that lie nearly in the same direction with the channel, which are much better than any single mark, buoy, or beacon, which single mark a ship may be kept stemming towards, and may seem to go in a fair way to it, yet by the tide or lee way, may be carried insensibly out of the channel on shore, by which I have known great loss and damage occasioned, for want of this being strictly noticed and guarded against, by observing the true bearings of the compass, or the lead and its stray line, how the ship goes over the ground, different to what she stems.

GOING with the ebb tide, makes it much more dangerous than proceeding with the flood, and especially where there is a great flow of water, which falls in proportion, so that if the ship comes a ground there is little chance of getting off again that tide, therefore it requires the more care and caution, and when it happens that you are obliged to proceed forward in the night, if a boat can be sent to shew a light where the buoys or dangers lie, that you

have to pass, I can say from experience, it may often prove a good method to keep clear of the ground.

If it happens by the set of the ebb tide, &c. that the ship is found to be out of the proper channel upon a shoal, and the wind so that you cannot shoot her off with the sails, it should be immediately resolved what is best to be done, whether the time of tide affords water to give the ship a chance to drive over the shoal, or you should let go the anchor, and endeavour to warp into the channel again; this has been my case, when I ordered the anchor to be let go, and begun to warp, but the tide fell so fast that the ship grounded upon the shoal, and I perceived afterwards she would have had water enough to have drove over the shoal, if we had not let go the anchor.

WHEN a ship comes aground, which is liable to take a great heel and may strain as the tide leaves her, the topmast should be struck that they may come easily down while she continues upright, and she should be eased from all tophamper, or it should be laid as low as possible, and when she begins to take her heel, the main and fore yards may be used for shores, and lashed to the chain plates, scuppers, &c. by which not only their weight is taken off the ship, but they may support her from straining, and when necessity requires it, the spare booms may be used for shores; and to lash iron crows with the sharp end below the end of each shore, may be a means to keep the lower ends fast to the ground.

The lower yards may be used as shores on occasion.

The compass and course to be looked after.

Now we may suppose a ship got to sea clear of these dangers that required a Pilot, who has now left the ship to the management of the commander, and proper officers. And when the course that is to be steered is ordered, the compasses should be examined to see that they traverse freely, and should be compared how they agree with each other, both in and out of the binnacle, and in comparing them, they must be placed at the distance of two feet, at least, a funder, for a reason which will appear in the next chapter. The binnacle should be cleared of all iron from about it, and if the commander be otherwise engaged, a proper officer should be appointed to attend to the course steered, and to the soundings of the lead, if it is kept going, to avoid what I have known in many instances, of ships being run on shore by course, when the blame has been laid on the compass.

WHILST one officer takes care of the ships course, &c. the ports and hatches to be secured other officers with the whole crew, according to their stations, should be properly employed, in clearing and preparing the ship to contend

contend with the turbulent waves of the sea, to prevent and guard as much as possible, against the bad and fatal consequences, which I have known to happen from shipping water before things have been properly secured. That the people may be properly refreshed with sleep, which nature demands, to enable them to do their duty as it ought to be done. As soon as things are got to rights to admit of it, the watch should be chose and set.

ON SHIP'S COMPASSES.

WHERE there are so many lives, and so much property depending on good Compasses, I have been surprized and vexed to hear some people begrudge the price of Dr. Knight's improved steering and azimuth Compasses. I thought, when I bought one of each, they not only deserved the price, but the inventer the thanks of the public, as a trading nation and a maritime power for so great an improvement in that important instrument. The needle which governs the card in this, is a strong artificial magnet of itself, and having an agot socket traverses upon a polished steel center pin, so that the ship's head cannot move the least degree to one side or the other, but these compasses instantaneously shew the motion, by which much better and safer steerage may be made, than with our common compasses, which are made very slight and imperfect, with needles that contain very little magnetic power, and have only rough, soft, brass sockets and center pins, which soon blunt, and are liable to be out of order, so as to prevent the card from traversing freely. A ship may move a great way from her course before it can be perceived by a bad compass, which may occasion dangerous steerage in spite of the best helm's man. Therefore, the best of compasses should always be allowed, and various kinds; as the difference will be but a little in the expence of a ship's out fit.

SOME late observations, and several experiments which I have made myself relative to them, prove, that a very material error in the course may be occasioned by having two compasses, with needles of strong magnetic power, at the same time in the binacle. For it is found that by their action one upon the other, they will vary, from two to three points, from the truth, when suffered to stand

ON SHIPS AND BOATS COMPASSES.

stand too near each other; a circumstance which it is very necessary a commander of a ship should be apprized of, that he may be upon his guard.---And it must be observed, that, the better the compasses the more liable they are to deviate from their true magnetic course: and the error will keep increasing in proportion as the ship is steering towards the S. W. or N. E. or N. W. and S. E. courses, when put close together they deviate two or three points. A vessel, sailing from *Wbtehaven* with two compasses in the binnacle with powerful magnets, gave occasion to this remark; for the Captain found them so erroneous that he put back again. And experiments I made in the presence of several judicious friends shewed the remark was a just one. Even on board a King's ship, I found (though the light room was large) two of Knights compasses, placed as far as could conveniently be a funder, yet affected each other a quarter of a point. I would therefore recommend the adopting the improved patent Binacle, in which one good compass, conveniently placed, answers every useful purpose, nor is liable to the above error.

ON SHIPS AND BOATS COMPASSES.

BUT of late years, there has been very great improvements made in ships compasses, for to make them stand the shock that ships and boats receive from waves, that has hitherto made the compasses vibrate from their true magnetic direction, which I have experienced, even Knights compasses to do.

As soon as I heard of the excellent principals of these compasses, I endeavoured and got one that was made by Ramsden, in *London*; with a spare light card when used in boats, which has hitherto been very much wanted, and sent them for trial to sea in one of our *Liverpool* Pilot Boats and had a good report of them.

BUT of late, I have seen here, one of Mr. M'Cullock's patent Azimuth Compasses from *London*, made on the most masterly scientific principals and mechanism, and a pamphlet with plates, descriptions and reports of it, and steering compasses for ships and boats; with the comparative surpassing great advantages over other compasses, from good authority by fair trials; which in the whole I think does honour to our country as a great maritime nation. And especially for his ingenuity in fixing the short pivot fast to the center

center of the strong magnet, that makes it traverse and turn so much easier with the center of motion so near the center of gravity, which is certainly a very great improvement.

ON CHOOSING THE WATCHES.

THE crew as far as they are known to be good and bad, should be equally divided and they should be told by the commander that the safety, ease, and success of the whole depends chiefly on every one doing or getting the necessary duty done, with watchfulness, care and diligence, according to their different stations, which he is in duty bound strictly to look after, and treat each of them as their merit, or demerit deserves. The watch upon deck have upon them the important charge, not only of the safety of the ship and their own lives, but the lives of the other watch and all that are below, therefore any neglect of duty by the watch upon deck, and especially in keeping a good look out, should be resented by all the rest of the crew: the watch below should lie down with such cloaths on, as to be ready to turn out directly, when all hands are called, which may be to save the whole from immediate destruction. These declarations help greatly to reconcile the crew in general, to that strict discipline, which may be absolutely necessary to be established at the beginning of the voyage, and especially when passing through dangerous narrow seas.

THE commanding officer of the watch, in my opinion, should not be put under that too common restriction, of being obliged to wait for the approbation and orders of his captain, when any unexpected great danger appears to be very near, but it should be recommended to him, to give such orders as in his judgment he may think the immediate necessity for safety require, to avoid the nearest danger, so as to give time to call on the captain to direct what is best to be done.

On

ON SHAPING A COURSE.

On shaping a Course, and managing through dangerous narrow Seas or Straits, where Tides or Currents run strong.

IN seas where shoals lie interspersed at a distance from the land, and where tides or currents run so strong as may greatly alter both the intended course and distance (which has to my knowledge occasioned many fatal losses) no pains should be spared in shaping the Course to calculate how the intended course and distance is to be made good, for it is well known that a strong tide or current has the same effect upon a ship's way at sea, though it may not be so visible, as in a river where it is plain to be seen, for which reason the setting and strength of the tide or current, as near as can be got, should be reckoned in the calculation, and set down in the log book as a course and distance in keeping the ship's way the same as the log, which ought to be hove and remarked every hour, and this is not too often, because in that time there may be great alterations in the ship's way, as well as the tide.

For these reasons as well as on other important occasions, every prudent diligent officer, should endeavour to get all the helps he can come at from tide tables, books, charts, &c. to make himself as well acquainted as possible with the tides, and should take all favourable opportunities to try and remark the ebbing and flowing, setting and strength of the tides as well as of the currents, that may be found in their track of navigation, in order to form a judgment how to allow and reckon them as a course and distance, in the account of the ship's way, as above recommended. This will certainly help him to come much nearer the designed course and distance in the account of them, but the velocity of the tide varies with its height, which will be mentioned from observations that cannot be ascertained by theory, and many other unavoidable errors occur in practical Navigation, which makes it so uncertain, and differ so much from the theory that makes the ship's reckoning answer to the greatest nicety upon paper, when in reality she is often found at a great distance from what was expected.

THE THEREFORE as so little dependance is to be put in reckoning the ship's way or place, it should not be thought wonderful in the course of a long winter's night, that instead of steering clear, or falling in with a place as expected, the ship is often found in another place, or from being on one side of the channel, she is found unexpectedly on the other, which makes it absolutely necessary, and

The uncertainty of practical navigation at sea.

and especially in the night or thick weather, to proceed with the utmost care and caution under such fail as the weather and situation will admit, so as to make the ship easily managed; a good look out being always properly kept. Whenever it happens that real danger unexpectedly appears, let not perverse obstinacy take place so as to lose time in doubting and disputing, but immediately use the best means to avoid the danger.

THE anchors and cables should be kept as ready as possible on these occasions. If the place you have fallen in with, cannot be known by the appearance it makes, take the bearings and extent of it each way by the compass, the depth of water, &c. and compare them with the chart of the place. This is the readiest and most likely means to find where you are, and which may be of the utmost consequence in proceeding forward or retreating, by this fresh departure being right; for I have known many losses occasioned by taking one place for another.

ON TURNING TO WINDWARD IN A NARROW SEA.

HOW far may it be right or wrong in bad weather, to keep beating against contrary winds in dangerous narrow seas, may be a disputed point, and must be left to the discretion of the prudent and discerning officer, who will consider his risque, wear and tear, with all the advantages, or disadvantages that may attend beating at sea: and that if obliged to bear away for a roadstead, even there, the wear, and sometimes the loss of the ground tackle, must be considered; also that the ship is liable to drive, or be drove on board of by other ships. The risk of going into and getting out of a port or roadstead should also be considered. So that when a ship can be kept at sea with any prudent degree of safety, though she cannot gain, but may lose ground; yet the chance it gives of being in a fair way for a change of wind, (and that varying but a little,) it may give an opportunity of making slants to get round a point or head land, or through the narrow sea into the open ocean: by which bravery there have been many instances of ships making a voyage: one did so to the *West Indies* and back again from *Liverpool*; whilst others were waiting there all that time for a fair wind.

BUT in a tide way, when the wind, weather, and navigation are such as will admit a ship to stop tide, it gives so great an advantage to gain ground to windward, that it may be deemed wrong

to lie waiting for a fair wind; for it may be, that the ship not only gains all that the tide runs her to windward, but it makes her hold a better wind to make her sail faster a head, than she would do with the same breeze of wind in still water; consequently she makes less lee-way; so that in smooth water it may be reckoned that the ship gains about one third to windward of what she sails by the log, as mentioned page 78: this, added to what the tide runs, may gain a great way to windward in a tide's working. When a ship comes to an anchor at slack tide, and the cable is veered out to ride by, all the lee tide, then heaving the lead, and the log every hour after, till the next slack tide, will give a favourable opportunity to observe the setting and strength, or velocity of it and what it ebbs or flows in every hour the whole tide, as also the time of each slack tide, with the moon's age, and her distance from the earth if it can be got; all which deserve to be particularly remarked in the journal,

WHEN the wind happens to blow so that the ship will lie up astern upon one tack, nearly to stem the lee tide; then the best management is, to stand on the other tack, with the windward tide, as far as the situation will admit with safety to get and keep to windward; which may give the opportunity to stand upon the flant; tack the whole lee-tide, so as to lose little ground, and save the risque of stoping the lee-tide, by coming to an anchor.

To sail
towards
shore the
first part of
the tide, and
off the
latter part
of it.

IT deserves to be noticed, that in narrow, seas or wide channels where the tides run strong, both flood and ebb, they begin first to run in shore, and run a great deal longer in the offing; therefore the advantage should be taken to stand as close in shore as safety will permit at the first making of the windward tide, and to stand to the offing the latter part of it; by which management our coasting ship's from being well acquainted, beat through the King's channel against fresh contrary winds that keep other ships windbound.

ON TAKING A DEPARTURE FROM THE LAND.

NOW let it be supposed that a ship has got far enough to sea to take her departure from the land, and is going to be navigated in the open ocean. The departure should, if possible, be taken from some remarkable head land or place that has its latitude and longitude well laid down in your books and charts; and

and if it lies in a fair way for a land-fall homeward bound, the more pains should be taken to get an observation with all the quadrants on board well adjusted according to rule; for which purpose you should examine how they agree with each other, and how they answer to the bearing and distance of the land of departure in sight as laid down; and a rough sketch of the appearance it makes should be taken, as also the soundings, at the same time, if they are a guide to the coast; all which should be fully remarked in the journals, not only for the reckoning outwards, but for safety in making a good land-fall, homeward, which depends much more on your own observations and remarks, than what can be found in any books or charts.

Difference between the Theory and Practice of Navigation.

AFTER the departure from the land is taken, then begins what we call the art of navigation, which, by mathematical rules, gives the true course and distance from one place or port to another, only by latitudes and longitudes being given, to reduce the various traversies a ship often makes in twenty-four hours into one course and distance, and to find the latitude and longitude the ship is in, by account, every day at noon; which, by theory, can be made to answer to the greatest nicety, so that a learner at school, can keep a reckoning of a long run, and make the designed land-fall agree to a mile with his account of the ship's way; but in practice it is found from experience, that it cannot be done so as to be solely relied upon, even by seamen of the greatest capacities, whose chief dependences, as before noticed, must be therefore on lead, latitude and a good look out.

THE difference between the Theory and Practice of navigation, arises from defects in the methods and instruments which we use in steering, and in the measuring and marking down the ship's way; and also in not making proper allowance for bad steering, lee-way, ship's drift, or bearing away from the true course in squalls, variation of the compass, and tides or currents; all which cannot be brought exactly to a regular account, but are liable to errors, depending much upon mens different judgments in correcting them: therefore each of these articles deserve to be particularly noticed, as they occasion not only the above difference, but the

ON STEERING IN GENERAL.

difference of one ship's reckoning from another on the same passage; and also one man's reckoning from another in the same ship.

ON STEERING IN GENERAL.

TH E difference between good and bad steering is of such consequence to navigation, that it deserves particular regard ; because good steering not only gives nearly the true course as steered by the compass, but the ship sails much faster and farther in the same time, and with much more ease both to the helm's-man and the ship in a gale of wind with turbulent waves ; for whatever a ship goes from her straight course, she shortens her distance gone so much, and requires more helm, which works and makes both ship and helm's-man very uneasy ; and when carrying a pressing sail, there is great danger of the ship being broached to, which may prove fatal to the whole : therefore all hints or helps, and every thing that good steering depends upon, should be made as easy and plain as possible. That most valuable instrument the *Compass*, has been already spoken of, see page 141.

ON THE STEERING WHEEL.

TH E great advantages experienced from steering a ship with this excellent machine, has occasioned it to become more and more in use ; even small ships that usually have their tillers upon deck, frequently now steer with a wheel, which gives the helmsman an additional power to command and move the helm at pleasure ; and as he stands firm on one spot, he can keep his eyes fixed on any mark a-head, or on the compass, and observe to a great nicety the ship's motions or tendency to go from her course : so that she may be steered steadier, and confined nearer to her true course by the wheel than by the tiller, which the helmsman must move along with from side to side as the ship requires, by which he cannot discern her motions so nicely, nor has he equal power to move the helm as occasion requires.

As the advantages of the wheel are so great, they deserve the more pains taken to have them made as perfect as possible. The barrel of

of the wheel, should be exactly proportioned to the size of the ship, that either three or five turns of the wheel-rope may be just long enough, so as to lose neither power nor time, in moving the helm three points of the compass each way from the direction of the keel, (as mentioned in page 47.) And as most of our wheels have eight spokes, and some large ships have nine or ten, the handle part of each spoke should be marked, so as they may be distinctly known by feeling, as they pass through the helmsman's hands. The midship spoke where the wheel-rope is nailed, may be marked with a rope-yarn, as in common; and the third or fourth spokes on each side may have I, II, III or IV notches cut with a knife; suppose on the fore side of the wheel on the starboard side, and on the after side of the wheel on the larboard side. The half turn spoke (if there is one) to be plain without any mark. By these marks it may be readily known where, or how far the helm is on either side, though the tiller is below and out of sight; and it gives the helmsman the liberty to use his eyes entirely in observing the ship's motions, and to steer her to the greatest advantage.

To have
the spokes
of the
wheel
marked.

I THINK the same kind of marks might be made to advantage on the out and inside of the spokes of *horizontal-wheels* that steer with tooth and pinion; and especially when the collar goes abaft the rudder head. This I look upon as an improvement in many respects; but do not speak from my own experience.

ON STEERING A COURSE.

IT is certainly the duty of the officer of the watch, to use his utmost endeavours to get the ship steered as near the course that is ordered as possible; and when the ship is perceived to be going exactly her course, by the compass, the helmsman should be advised to look and find a mark a-head that will not soon alter, to steer by; and only to look at the compass now and then, as occasion may require, to observe whether the mark alter afterwards so as to make it necessary to find out another that will answer nearer to the course; for it is well known that a learner will steer a ship to a greater nicety by a mark a-head, than a good helmsman can do without a mark by the compass alone.

A GOOD

A GOOD helmsman, when a ship is difficult to be steered, at taking the helm, first observes how it lies; then looks with a sharp eye which way the ship is inclined to go from her course, and moves the helm with a brisk motion far enough to stop her that way, and feels by the stress upon the rudder ceasing, (which feel ought always to be noticed, as well as any alteration to the eye) when it is a proper time to ease the helm to prevent her from going on the other side of her course; for a ship is no sooner stopt by the helm from going to one hand, than she will incline to the other hand, if the helm is let lie in that place; therefore he keeps moving the helm with a brisk motion, as far as is found necessary, to confine her to the course; and by feeling the marked spokes of the wheel, as they come into his hands, soon perceives how much helm, and how far she requires it each way, to command and steer her steadily along, with the least helm, and least trouble to himself.

A BAD helmsman, instead of endeavouring to confine the ship to her course, by moving the helm each way, as above mentioned, commonly lets the helm lie until he sees the ship is got on one side of her course, then moves it so far as to bring her to her course again before he offers to stop her, or meet her with it, till she gets on the other side of her course, so as to require a great deal of helm both ways; by which the ship is steered but little right forward, but is kept yawing about from one side of her course to the other; which shortens the distance gone, and makes both course and distance very uncertain, and works the bad helmsman as he works the ship from side to side; which makes both very uneasy; and if the waves run high, when carrying a press-gang sail, large, by such bad steering there is great danger of broaching the ship to; therefore none but the best helmsman should be permitted to steer at such times.

On suiting a SHIP with SAIL that she may be well Steered.

WHEN it is difficult to steer a ship, her officers should take care that her sails are kept properly trimmed, and that she is not over pressed with sail; especially after sail; which may make her so ungovernable, as to put it out of the power of the best helmsmen to steer her, with all the helm that can be given her:

her: therefore the helmsman should always be told to acquaint the officer of the watch when the ship gripes so hard that the helm hard a weather, or hard over each way, will not command her, that the sails may be better trimmed, or aftersail taken in, or more headsail set, as the occasion may require.

ON STEERING UPON A WIND IN THE OPEN OCEAN.

IN a variable wind's way, when a ship has got sea room, clear of the land, I have thought it a wrong practice to steer upon a wind by the vanes, and the sails just touching full; which seldom give a direct course, but vary as the ship comes to, and falls off; which makes both course and distance the more uncertain; therefore a course should be ordered to a point, or half a point of the compass, as the wind will admit, to steer the ship with a full sail; and only look at the vanes to see if the wind alters, that the course may be altered accordingly: by this means a truer course as well as distance may be got: especially if the ship lies astern towards her true course, it is the more necessary, as the ship will sail the faster, and make less lee-way; and this last should be well considered, because the ship's real course by the compass depends much upon making a proper allowance for her lee-way.

ON MAKING ALLOWANCE FOR LEE-WAY.

THIS, in a most inconsistent manner, is generally left for twenty four hours to the judgment and memory of the different navigators, who probably are below a sleep, or their attention taken up with other things great part of the time; this therefore must make the allowance for lee-way very uncertain, as it is liable to vary, and be more or less every hour, as the wind happens to vary, blow less or more, or the waves run higher or lower, more a head, or a stern of the ship, and as she has been steered upon the wind, though under the same sail; and differs greatly from any school boys rules, that can be proposed, of allowing more or less lee-way, according to the sail a ship can carry; for it is well known that two ships may be in company with

ON MAKING ALLOWANCE FOR LEE-WAY.

with equal sail set, when one, by her construction and trim, may not make half so much lee-way as the other.

THIS defective and uncertain manner of making allowance for lee-way, in my opinion, is one of the principal causes and reasons that can be given, why the reckonings in the same ship should differ so much from each other, when the courses and distances that the ship's way is reckoned from, are all taken from the same log-book; which if no mistake be made in the calculations, should make them all nearly agree.

WHAT in my opinion would contribute greatly to lessen this defective part of navigation, is to have a quarter of a circle of sheet lead, divided so as to make the eight points of the compass, and nailed upon each quarter, with one side parallel to the keel, and the other to the beam, as they have in most capital ships; by which the ship's wake, or drift, tha. she goes to lee-ward of what she stems by the compass, may be set to a sufficient nicely upon both tacks, by the officer of the watch, who shoud make the allowance, and set down the real course or drift made by the compass, every hour; which by this means will certainly come much nearer the true course, than when left without any rule, to different peoples memories, and judgments, as above mentioned.

To have
4 quarter
circles
pointing
to each
quarter
and bow.

HERE I think it proper to remark; as these quarter circles of lead are commonly made and cut from a whole circle of about six inches diameter, with the 32 points of the compass scratched out in straight lines from the center, the other two quarters should be nailed on each side of the baricado; or fore part of the quarter deck, pointing on each bow before the beam, as those a-bait point a-bait the beam; so that any objects, such as ships, points of land, shoals, buoys, or beacons, may be readily set by these quarter circles, to know how far they are before, or abaft the beam; and by observing how the ship stems by the compass at the same time, the bearing and alteration of bearings, may be easily a d readily taken, which I can say from experiance will often prove of great service.

THIS

THIS method, defective as it is, must be made the most of, till a better is brought into practice. For it is well known how many ingenious Mechanics have repeatedly made promising trials, to measure a ship's way at sea by machines without succeeding. We had one made at *Liverpool*, by means of an iron rod, to be fixed at the fore-side of the stempost, which answered very well by the mile stones in our canal; and, by subscription, had it fixed for the inventor to go a voyage to *Jamaica* with; but it failed of success; and he did not return with the ship.

THE learned have, with much seeming reason, recommended to us to have our log-lines marked fifty feet to a knot, and the glafs to measure thirty seconds of time, which are exactly 120th part of a geographical mile, and of an hour, and must be allowed to agree better with exact calculation than our common practice of having but forty two feet of line, to a glass of twenty eight seconds of time; which line is four feet eight inches, or about a ninth part short of the above proportion; yet, in our practice, this is found from long experience to measure very well a geographical or sea mile of sixty to a degree; which mile, in my opinion should become general, and be used in the scale of all our sea maps, instead of our English statute mile, which is about a seventh part less; by which difference the unlearned may be deceived.

COMMON practice can only be proved to be right, by frequent fair trials. I was mate of a ship in the *Jamaica* trade from *London*, outward bound; and we marked the log-line seven fathom to a knot, (to a twenty eight second glafs as usual) till we were disappointed of seeing our expected land fall according to our reckonings. Our commander then asked, "how had we marked the log-line?" He was answered, seven fathom to a knot. He then ordered the line to be immediately new marked eight fathom to a knot, and said "that the ship was one eight part short of her longitude, by the line being marked seven fathoms instead of eight to a knot;" and so it proved; for we made the land as he said. But in our passage home by this rule, we found the ship a great deal above an eight part of the longitude a head of all our reckonings; which nearly proved of fatal consequence, as we were carrying all the sail possible with a westerly gale of wind and hazy weather; when we luckily perceived by the colour of the water that we must be in soundings; and it proved so; and we found ourselves far up the King's channel in a fair way, and had escaped a great risk of running the ship on shore unexpectedly with.

with all sails set. This convinced me that it was not the fault of the log-line being marked seven fathom, but another cause that may be mentioned hereafter, and that is known always to have this effect upon ships in their voyages to and from the *West Indies*, so as to make more difference of longitude out than they do home.

To mark the line and try the glass. THE proportion of seven fathom of line, to a glass of twenty-eight second's being right, is confirmed by the general practice in the *East India* trade, as well as all other trades that I have been in. My opinion is, that it will stand the test of any fair trial. In a voyage to *Leighorn*, the ingenious Mr. *Smeaton*, sent with me for trial, a Sea-way Measurer, and what should be properly called *Smeaton's and Knight's* improved compasses; for to my knowledge, the former contrived the mechanical part of them; and also his artificial Horizon for trials; which made me take extraordinary pains to have our log kept nicely marked as above, and to be hove regularly every hour, in order to find out by experience how many turns of this way measurer answered to a mile. To fix this to a great certainty, I took an opportunity that then offered, and steered to the westward, till we could steer a cross the Bay of *Biscay*, and along the coast of *Portugal*, as near upon the true meridian to the southward as possible; where we reckoned there was neither tide nor current to affect a ship's way; and had the favourable opportunity of fair wind and weather, to compare our distance run by the log, to what was made by good obervations for several days; and I found that they nearly agreed: which I think makes it evident that these proportions for the log answer very well if properly attended to; and therefore cannot be the cause which occasions bad reckonings: and if it is an error, it must be allowed to be on the best and safest side; as it is better that the reckoning should be rather a head than a stern of the ship, to put people upon their guard in proper time, so as to prevent the fatal consequence that may attend an unexpected land fall.

Proportions for the line and glass. THE readiest and surest way to make and try the log-line, is to have the whole length of the half knot (twenty one feet) measured and marked straight along the deck; and to have the knots put into the line so as they may be easily shifted backwards, or forwards, as the stretching and shrinking of the line often requires. But before this is done, the half minute glass should be tried, whether it runs exactly twenty eight seconds; that if it is found to run more or less, the line should be marked longer or shorter according

according to these proportions. As 28 gives 42, what will a second or two more or less give? And this may be done sufficiently near by the scale and compasses. And the glasses may be tried by a musket ball fastened to a thread held steady in one hand, between the finger and thumb, exactly 30 inches from the ball; which must be swung by the other hand, and continued swinging more than 30 times; by which I have found from frequent experience, each swing then measured a second of time, sufficiently near for this purpose, even when the ship had some motion from the waves. But the best instrument for this purpose, as well as many other useful and curious purposes at sea, is a good watch, or time keeper, that shews seconds, which will answer equally as well in a storm when the waves run high, as in smooth water; therefore every officer that has the charge of navigating a ship, should have one of the best he can afford to buy.

IT is a sufficient trial for the quarter minute glass, if it runs out exactly twice, for the half minute glass once. But after all one's care in finding out exact proportions, by which to get the true distance run, the whole depends chiefly on those who heave the log, and hold the glass; neither of which should be done by careless people; especially when the ship sails so fast as to require to use the quarter minute glass; which will double all errors; therefore this glass should be as seldom used as possible.

THE Learned, as before mentioned, have very justly recommended to have the line that is run out above the knots, set down in fathoms of five feet each; being the tenth part of their 50 feet knots. The same exact rule may be easily used, only by having a measure of four feet, two inches and a half (marked on the rail, on each quarter where the log is hove) that will measure tenths of a mile from our 42 feet knots; which it must be allowed will come much nearer the true distance; and agree much better to the tenths of miles in the traverse tables, than that old and bad practice of setting down nothing less than the half knots, or that more exact method of marking down to fathoms of six feet; and these tenths of a knot above or under the knot or half knot, might be very easily measured by the officer that heaves the log.

BUT after all the exactest rules, the most effectual method in my opinion to try what dependence can be put upon the log, and those that heave it, is that I have before mentioned, if opportunity permits, clear of tides or currents, after a good observation had for the latitudes; that is, to allow for the variation, and steer due

ON MARKING DOWN THE LOG.

N. or S. till a second observation, if it can be done in a favourable time; which will give the truer real distance that can be got at sea to compare with the Log.

On Heaving and Marking down the Log, once in two Hours only; or every Hour.

IT surprises me to find the old practice, of heaving the log only once in two hours, still continued in many capital merchant's ships; because it makes the unavoidable errors in getting the true course and distance, not only greater, but doubles them in working the day's work; and marks down not nearer than half knots of the odd line; which must still increase the errors of the distance; for if we suppose two fathom of odd line is omitted to be set down every time the log is hove, it makes a difference of near seven miles in the 24 hours.

THIS practice lies under another great disadvantage, which is that of not affording sufficient room to set down and explain the necessary remarks and occurrences, that often happen in the twenty four hours.

On Heaving and Marking down the Log every Hour.

THIS practice, compared with that above, has many advantages attending it. Those unavoidable errors arising from the wind and weather, and the ship's sailing faster or slower than when the log is hove, must be lessened one half; and the odd line that is run out, marked down in fathoms, or tenths of a knot, every hour, must certainly come much nearer the true course and distance than the above old method.

BUT it must be allowed, that they who have been accustomed to the old method, may be a little perplexed in working the day's work, and reckoning those odd fathoms, or tenths of a knot, that are left above the miles the ship has gone on any one course; and which is under no fixed rule; but when they amount to above half a knot, let them allow a mile; and when under half a knot, omit them, as fractions to be left, and as many other material things

things must be, to the judgement and industry of the navigator, on which depends chiefly all comparative good reckonings.

As to the difference of trouble in this method, it should not be mentioned, if it is allowed to contribute to lessen the defects of navigation; which it certainly does; and therefore should become general. I will then take the liberty to shew, in a day's work, my manner of keeping a ship's way at Sea, and which I learned first in the *East India Trade*; so that they who have been used to the other method, may compare and judge for themselves.

SHIP LIVERPOOL, through St. George's Channel, 1773.

Remarks.	H.	K.	F.	Course.	Wind.	Monday, March 6.
A fresh breeze, hazy with small rain.	1	5	—	S. S. W.	N.E.b.N.	The first part a steady fresh breeze, and hazy with small rain; the latter part a strong gale with high waves; and thick rainy weather; at A M. H. M. fall; at 8 A. M. rear- ed to the W. ward to keep clear of Scilly islands; at 10 lowered the T. Sails down on the caps; other remarks. as per margin..
Cloudy & thick with small rain.	2	3	3	—	—	
	3	3	4	—	—	
	4	3	4	—	—	
	5	4	2	—	—	
	6	5	3	S.bW. $\frac{1}{2}$ W	N. E.	
	7	5	5	—	—	
	8	4	5	—	—	
	9	5	—	—	—	
	10	6	4	—	—	
	11	6	3	—	—	
In 1st and 2d. R. T. Sls. and	12	7	4	—	—	Course with the bearings from. the hill of Hoath yesterday S.
Hd. Mizen T.	1	8	3	—	—	15d. W. dist. 176 miles, S. ing 170 miles W. ing 45 miles.
Hd. Mizen T.	2	8	—	S. W.	—	
Sl. A strong gale Hd. M.	3	8	—	—	—	
Sail, a great sea and small rain.	4	8	—	—	—	
	5	8	5	—	—	
	6	9	—	—	—	
	7	9	1	—	—	
	8	9	2	S.W.bW.	—	
Lowered T. Sls. on the caps.	9	9	4	W.	—	
	10	9	4	—	—	
	11	9	4	—	—	
	12	9	—	—	—	

Distance run 167 $\frac{1}{4}$ miles.

The next Day at Noon.

Course allowed S 28d W. dist. 110 miles
S. ing 97 miles W. ing 52.
Latitude observed, 48 45 $\frac{1}{2}$ N.
By Account, 48 30 $\frac{1}{2}$
Meridian Dist. 1 37 $\frac{1}{2}$ W.
Longitude in 9 15 $\frac{1}{2}$ W.

By

By this method, the remarks of each watch may be briefly set down in the margin; so that all that is most material, may be fully described in filling up the log book, or journal for the day; only leaving room at bottom for the ship's course and distance, and the latitude and longitude she is reckoned to be in at noon; which will prove much better, for many reasons, than that method of setting down the difference by longitude, to avoid exposing how much the longitude reckoned to be in may be wrong; which by the bye can be no disgrace to a man when he does his best. It is likewise necessary to draw the track of each day from one latitude and longitude to the other, with a black lead pencil, on the general chart, to compare the ship's situation with the nearest land, or shoals, to prevent as much as possible being surprised by unexpected dangers.

ON A SHIP WHEN IN THE OPEN OCEAN.

AFTER a good look out, as mentioned in page 115, the principal dangers now to contend with, are violent winds, and waves; for which the ship should be prepared; and every thing secured and made as snug as possible, according to the weather that may be expected, and as the length of the run may require. The cables may be unbent; the haufe holes plugged up, if they lie low; and the bower anchors stowed somewhere within board; which is not only a great ease to a ship, but may make her sail faster, as mentioned in page 59; and may prevent the foot of the fore-sail from chafing against the upper arms of the stocks, and the lower arms from plunging into the water; which may affect both the ship's way and the steerage. All top-hamper that is now unnecessary and can be spared aloft, should be got down and stowed below; such as top ropes, top blocks, maules, runners, and tackles; which may ease the masts, and prevent a great deal of chafing amongst the rigging.

IN

IN variable winds, when the ship will sail a flant, stemming near her intended course, it is natural to stand upon that tack as long as circumstances will admit; because the wind may vary, so as to enable you to make a flant on the other tack; by which a ship may be got slanting forward on her way. Then it may be worth while to carry a pressing sail, if it blows fresh, and steer by the compass a little from the wind, as recommended in page 151; which may contributely greatly to shorten a passage.

BUT when the wind blows strong, and the waves run high near to the point of the intended course, so that nothing of a flant can be made on either tack; then it may be deemed very wrong to press and strain a ship with any more sail than to make her rise and fall easy with the waves; for a little time, with a favourable wind, will fetch up what may be lost by taking in sail in good time to give ease to the ship, masts, rigging, &c.

On taking in SAILS to save them, and give ease to a SHIP when failing upon a Wind in a Storm.

ON these occasions, the climate, season of the year, frequency of the wind blowing strong in one quarter, and the appearance of good or bad weather that may be then expected, with all other circumstances of the ship, men and materials, should be considered, to form a judgment how to act when it comes to blow so fresh that the topsails cannot be carried without being reefed; and then if the top-gallant yards are up, whether it may not be necessary to get them down, and strike the top-gallant-masts (if they go a baft the top-masts as mentioned page 51); and especially if it is at the beginning of a long winter's night, in which time both wind and waves may be increased to a violent degree before morning, and which may make the ship pitch, roll, and labour, so as greatly to strain every thing, and make it dangerous for the people to get them down at such times: and if the wind and weather should prove favourable, they may be easily got up again in the morning; and by this practice, at the first of the voyage in smooth water, the people will learn to be expert in getting them down or up, as occasion may require.

As the wind and waves increase, a fast sailing ship, upon a wind, when pressed with sail, (especially head sail) will be plunged deep

deep into the sea, and increase her pitching motion to a dangerous degree. This I have experienced in chafing upon a wind, when both the pumps, and bailing at three hatchways, could not keep the ship free from water, till the chase bore away before the wind; by which movement she soon became our prize; for we could not have chased her much longer upon a wind, owing to the sharpness and weakness of our ship's bows, as mentioned page 22.

LET us now suppose a ship brought under her close reefed top-sails, the top-gallant-yards and masts down, and every thing made snug, according to the appearance of such wind and weather as may be expected. Getting the spritsail yard and jibboom in upon deck, to beat against westerly storms, is certainly a help, and gives great ease to a ship on such occasions. Let us also suppose the gale to increase, so that the square-sails must be taken in; in doing of which, they are very liable to be split and blown to pieces by flapping, if proper management is not used to preserve them; which deserves notice: and when ships are known to be very laboursome, the close reefed main-top-sail upon the cap, ought to be the last sail taken in; because that sail, standing so high, contributes greatly to prevent the ship labouring, and is always necessary when a ship is obliged to scud before the wind for safety when the waves run high.

On taking in Square Sails upon a WIND in a STORM.

INSTEAD of the old practice of clewing up the lee sheets first, (by which the leeches of the sails flap very much) it is certainly best to clue up the weather sheets, or tacks, first, when taking in the top-sails or courses; which keeps the sails full, and prevents their flapping, till the weather bowlines and lee braces are let go, and the lee sheets let fly; when, the sails fly instantly aback of themselves, so that they may be clued up with great safety.

ON BRAILING UP THE MIZEN IN A STORM.

EVEN this requires management at times ; when, the **only** method to still the sail, and prevent its flapping, so that it may be furl'd easily, is to man well and haul upon the lee brails only ; and only take in the slack of the weather brails, till the lee ones are close up. For if the weather brails are too much haul'd upon, it will fill the sail so full of wind, as to prevent its being furled. As to the taking in the Fore, Main, or Mizen Stay-sails ; they only require to be hauled briskly down, that they may be furled or stowed away as brisk as possible, to prevent their flapping.

On taking in the Square Sails when sailing large, or before the Wind, in a Storm.

WHEN the wind is on either quarter, the lee sheet should be first clued up ; then the yard pointed to the wind ; and the buntlings, &c. hauled, as much as possible, before the weather sheet is let go, if the sail cannot be backed. The wind blowing nearly along the yard, will preserve the sail greatly from flapping ; so much as it would do if the yard is let lie square to the wind.

WHEN the wind is right aft, one sheet should be clued up first : then, with the brace on the other side, the yard should be braced as sharp up as possible ; haul up the bunt and leech lines, as much as they can be, before the other sheet is let go : and if, to save the sail, and things will admit, that the ship could be steered with the yard pointing to the wind, for a little while, it may contribute greatly to save and get the sail secured.

BUT on all such occasions as these, and especially in the night, when the word of command cannot be heard, nor can the people see, or be seen by the officers, so as to be directed by any means to get the duty done as it ought to be, the only method is to mutter the people altogether first, and make known what, and how the thing is intended to be done, and station them accordingly, that none may plead ignorance in excuse for any mismanagement that may happen.

WHEN

WHEN a ship will not bear to carry her courses, it is certainly the best practice, first to secure and hand the mainsail (as the foresail may be carried a great deal longer) and, with the mizen and main-fore-stay-sails, a ship may be steered close to the wind, so as to make her tolerably easy and lively in the sea; and especially when beating to windward in narrow seas, these are the most suitable sails a ship can be under at such times, because they may be the more easily and readily weared: and when the storm increases, so that the ship will not bear to carry the foresail, it may be taken in with great advantage in the time of wearing, by the above mentioned rules. After the people are got together, and the intended method of proceeding made known to them all, as soon as the ship is perceived to begin to wear, the yard being kept braced sharp up, the tack and bowline may be let go, and the weather-clue garnet hauled up; and when the ship is nearly before the wind, the bunt and leech lines, and the other clue garnet, may be hauled up, and, if the situation admits, and the occasion requires it, the ship may be steered with the wind on the quarter, till the sail is secured.

ON LAYING A SHIP TO IN A STORM.

THIS is intended, as much as possible, to preserve a ship from the dangerous effects of violent wind and waves, by endeavouring to steady her from labouring, and make her rise and fall with the waves as lively, and easy in the sea, as possible; and the best method for doing this, I can assert from long experience, is, for the ship to be under her lower or storm staysails, with the mizen reefed, and balanced, &c. and the yards braced full, as represented in plate 6, fig. 2, and not by the common method of laying a ship to, under a reefed or a whole mainsail, with the foresail aback in the brails, as represented in fig. 1, of the same plate.

On lying to under a Mainsail, with the Fore sail aback in the Brails.

THAT this method is far from being the best to answer the above mentioned purposes, may be proved from reason as well as experience; for if a ship be laid to in this manner, with

some sails full, and some aback, and the helm made fast a lee, as is customary, instead of keeping her bow to the wind and waves (which, only, can keep her easy in the sea) she will be constantly coming to the wind, so as to shake the weather leech of the mainsail by her head-way. The foresail being aback, and the power of the waves a head, soon give the ship great stern-way; and the helm being a lee, as before mentioned, makes her fall round off, four or five points from the wind, which causes the ship to labour and strain in proportion as she comes to and falls off from the wind, and also exposes those flat and weakest parts, the counter, stern, quarter, and broadside, to bear the shocks of violent and dangerous waves, that sometimes break in and do great damage; and the mainsail is often split from such a cause, as well as by the power of the wind. The quickness of the ship's rolling motion, from the ascending to the descending side of a high steep wave, acts with more or less force, in proportion to the bigness of the sails, to split them.

FACTS, derived from experience, are the only confirmation of a practice being right or wrong. I was in one of our *East India* ships, bound home late in the season, and was five weeks beating round the *Cape of Good Hope*, against westerly storms; when, to preserve and keep the ship from rolling too much, we often laid her to, under a whole mainsail, with the foresail aback in the brails, as represented fig. 1, plate the 6th; when the above mentioned bad custom split our mainsails faster than we could repair them, till we had none to bring to the yard, but were obliged to wait till they were mended; and they split again in less time than was taken up in mending them; during which time we commonly laid to under the mizen, when, for want of a little more sail to steady her amongst the waves, she became more exposed to those dangers above mentioned, labouring with a more quick, jerking and deeper rolling motion in the sea; and we found the want of the mainsail (which is the most material sail upon a wind) to take the advantage at such times as the wind varied so as to enable us to make slants, and by which only we got round the *Cape*, after the time that is said to be limited by the Company to prevent damage to their ships and cargoes.

On a SHIP under STORM, or lower Stay-sails and Mizen, in a STORM.

FOR the reasons now mentioned, after long experience, my practice has been (instead of laying the ship to in this manner) first to secure and hand the mainsail, and, if the gale increased, I handed the fore-sail, and reefed and balanced the mizen. The mizen, main, fore, and fore-top-mast-stay-sails were kept set, as we might have done with the above mentioned ship, or such another as is represented figure 2, in the same plate; where both methods may be seen, in order to make a fair comparison of the two from practical facts.

On the advantages of a SHIP being kept under lower or Storm Stay-sails and Mizen, instead of lying to in a Storm.

FROM what has been said, it may justly be concluded; that a ship laid to with the helm a lee, must be constantly coming to, and falling off from the wind, more or less, in proportion to her head and stern-way; so that when a ship is laid to in a storm, (as represented fig. 1, plate the 6th) and that the power of high waves are added to the wind, she must naturally run up too near the wind by her head-way; and then both wind and waves unite to give her stern-way, which makes her fall round off, and throws her stern up against the wind and waves, which then act very powerfully against those tender parts, till she gets head-way again, and makes the ship uneasy, and laboursome to a dangerous degree, as above mentioned; to avoid which, I strongly recommend to keep the ship under-way, under her lower, or storm, stay-sails, as they may be called, with the reefed and balanced mizen set, and the yards braced sharp full, as represented by fig. 2, plate the 6th; which will certainly contribute greatly towards producing the following advantages.

By this method a ship may be kept with so much head-way upon her, as to be under the command of the helm, and to steer her nearly to a course, six points from the wind, which ought by all means to be endeavoured after, to keep her bow (that bold and strongest part) pointing to the waves, where they can do her the least damage, and which makes the ship at the same time much easier

easier and livelier in the sea, than being laid to as above mentioned. And these small sails are handy and strong, compared with the mainsail, being commonly made of equally strong canvas, and proportionably less liable to be split, either by the wind or waves, and can be set, or taken in easily with safety, and they stand so flat, and fairly divided from the bowsprit end to the stern, as tend greatly to steady the ship, as well as ease all the masts, yards, and rigging from jerking and chafing in her rolling, and to preserve the mainsail and foresail (the two most material sails that are to be depended upon) on any extraordinary occasion that may require their being set and carried, upon a wind, in bad weather.

For these reasons, where ships do not wear and use amain and fore-stay-sail in common, I would recommend to have them as ready to be bent and set as possible on these occasions, having hanks upon the stays, and gromets upon the sails, for that purpose.

On bearing away in a Storm, to scud before the Wind and Waves.

WHEN the waves run high, and sudden necessity requires to bear away, it should be considered, that the low headsails which the ship may be weared under, when she comes before the wind, may be becalmed by the height of the waves, which may break violently against the stern, and fill the deck with water; but, that loftier sails being set, would give the ship more way through the water.

I HAD an instance of this, in a cruising ship, under low sails upon a wind in a storm; when the ship and all things forward gave way so much, as obliged us to bear away before the wind; and the low sails we had weared under, being becalmed by the height of the waves when the ship was in the hollow part of the sea, the waves came running against the stern with great violence, and filled the deck with water; which frightened the people so, that several of them called out with tears in their eyes, that the ship would founder: we got the close reefed main-top sail set, which had the designed good effect to catch the wind, and always kept drawing full above the waves; this increased the ship's way so much, that the waves did not reach her with above half the velocity and power as before, and gave the ship time to rise and fall gently

On sailing LARGE, or before the WIND, in SQUALLS

16.

gently with them, without shipping much water ; for the waves I suppose might run at the rate of about twenty miles an hour, the wind going at about fifty, and the ship above ten miles by the log, which naturally lessened the power and violence of the waves above one half upon the ship. This proves the advantage, and even the necessity there is for having a close reefed main-top-sail ready to set when going to scud before high waves ; and should be the last square sail that is taken in, in a laboursome ship.

On sailing LARGE, or before the WIND, in SQUALLS.

PROCEEDING in squally weather, must be left to the judgment and prudence of the officer that has the command, to act as circumstances and the situation of the ship and crew will admit, and to run more or less risk, in carrying sail more or less, accordingly. But this I can say from experience, that it is not sufficient that a ship can be got before the wind at the time of a heavy squall with a great deal of sail set, as it may endanger not only the masts and sails, but the ship may be so overpressed with sail as to put it out of the power of the helm, and the best helmsman, to steer her from broaching to, which may prove fatal to the whole.

WHERE rules cannot be fixed, the result of facts from experience must be our only guide. I was in a ship in the *Jamaica* trade from *London*, where our commander would not permit any sail to be shortened or taken in, without his order or consent, when carrying a pressing sail, large, with a Westerly gale. At the coming on of a squall of wind, he was called upon ; and when he came upon deck, he took the command, and directed the helmsman to endeavour to keep and steer the ship right before the wind, without shortening sail ; but the ship was so pressed with sail, as to lose the power of the helm to steer her, which almost proved fatal to us all.

ALL unnecessary daring risks of every kind, when there is no pressing occasion to require such, should be avoided and condemned as the greatest folly ; for there can be but little lost, and a great deal may be saved, by lowering or taking in sail, in good time, when a ship is sailing large, or before the wind in the time of a squall ; as sails may be soon and easily set again, when the squall is

is over, which may be the means of preventing great loss or damage.

AMONG many instances of this kind that I have known, I met with one, by the foolhardiness of a *London* pilot, who would not let our sails be lowered, when sailing before the wind in a squall; which made the masts bend so much, that when we wanted to clue down the top-gallant-sails, and top-sails, we could not get them down; which shews the necessity there is of clueing these sails down, and securing them down, and from flying up again before a squall comes on: for had this squall proved any stronger, or continued any longer, we must have lost our masts, in spite of our utmost endeavours.

THIS shews the folly of running such imprudent risks, when little or no advantage can be gained by it; for it may be a disputed point whether a ship sails any faster for being thus overpressed with sail to such a dangerous degree, when sailing large or before the wind. But a ship sailing upon a wind in squally weather, may often be under a necessity to carry a pressing sail; yet then it should be considered, that if the top-sails, &c. are not clued down in good time, that the heeling of the ship, added to the bending of the masts, may hinder the top-sails, &c. from being got down in the time of a squall, which may prove of bad consequence.

On scudding or sailing before the WIND in a STORM.

MANY precautions are necessary on this occasion. Every thing abaft, and about the mizen-mast, should be taken in, and stowed away as snug as possible; and I have known the mizen gaff lowered close down on the occasion.

If the waves run high, it may be absolutely necessary, for the reasons given, to have a close reefed main-top-sail set, though only scudding before the wind, for the ease and safety of the ship.

BUT when carrying a pressing sail, to make the most of a storm, great care should be taken that suitable sails are only set; and they should be trimmed to the best advantage, so that the ship may be kept under the command of the helm, which should be strictly noticed by the commanding officer of the watch: for it should be considered, that a ship at such times may be so overpressed, and plunged

plunged so deep into the sea, forward, with sail, that instead of dividing the water on each side, in an easy manner, the full parts of the bow, and other stops not designed to be in the water, drive a great body of water above its natural level before her bows, which may increase the resistance a head to such a degree, as will rather decrease than increase the ship's head-way, and that in proportion to this rise of water; and the stern being lifted up as much as the head is pressed down, the helm must then naturally lose so much of its power at the same time; so that when the wind may be going four times as fast as the ship, and the waves twice as fast, it is not to be wondered at that ships are sometimes broached to, against the power of the helm. The remarkable loss of the *Sussex East-India* ship homeward bound from *China*, in the year 1737, first arose from her being broached to, when sailing before the wind..

WHAT has been said on this occasion, shews the necessity for much care and pains to be taken, both by the officer and helmsman, as before recommended; and none but the best helmsmen should be admitted to steer at such times; and whenever danger appears from one man's steering, others should be tried, and the sails altered and trimmed to the best advantage, that if possible the ship may be steered without the danger of being broached to. A great risk attends relieving the helmsman; especially in the night; as he that is to take the helm, often comes but half awake from sleep, and takes the helm without examining where it lies at the time, and how far the ship requires it each way to confine her to the course; thus, not considering the danger, he at first lets the ship get such a sheer, that his best endeavours afterwards cannot stop her from being broached to, or brought by the lee. To prevent which, the helmsman that is to be relieved, if he has steered well, should not quit the helm before he has shewed and made known to him that is to relieve, the particulars of her trim, and how she may be best steered at that time, how many turns and spokes of the wheel she requires to starboard and port, or to windward and leeward, to confine her to her course.

IT is well known, that there is a great difference in ships steering, according to their built and trim. Full built ships, when deep loaded, are often difficult to be steered, when sailing large in a gale of wind. I have been told of some that could not be steered to their intended course before the wind, but would broach to each way in spite of the best endeavours, so that they have been obliged

On relieving the
helmsman.

ON CUNNING TO THE HELMSMAN.

Hints to prevent broaching

to lie to with a fair wind; which has often happened to an expert diligent officer of my acquaintance: therefore every hint that has the least reasonable appearance to remedy this evil, deserves attention, and should be tried. On this occasion, when a ship cannot be steered right before the wind without broaching to; suppose a trial should be made to steer her with the wind two or three points first on one quarter, then upon the other, for a little time each way? This reduces the danger to only being liable of broaching to, one way; that is, to windward; which may be much easier guarded against by the weather helm this one way, than both: And if we suppose the ship to be steered with the wind on the larboard quarter, with the clove-reefed main-top-sail set and braced up with the larboard braces, and the head-sail trimmed sharp the other way, with the starboard braces and the helm a-weather, (as represented in the plan of the ship, figure 1, plate 7,) it evidently tends greatly to counteract and get the better of those causes, before mentioned, which occasion a ship to broach to; and may keep her under the command of the helm. But if this method should not answer, there is another which I think could not fail of success; that is, to veer out, and tow right over the stern, a tow-line, or hawser, or as much of a cable end as may be found sufficient to keep the ship before the wind, and prevent her broaching to.

AT such times as these, when a ship cannot be steered to the course that is ordered, it should be recommended to the officer of the watch to take particular notice which way she goes most from her course, to make an allowance and mark it down accordingly.

On CUNNING TO THE HELMSMAN.

THIS custom is useful in general, even when done by a quartermaster; it answers the good purpose to confine the thoughts and attention of the helmsman to his duty; as he is obliged to repeat the cun, though he with reason, (as I have often done,) moves the helm contrary to the cun, in order to confine the ship to her course, by such management as before mentioned. The good helmsman, after a little experience of the ship's trim, must be allowed to know best what helm is required to steer a direct course.

But

BUT when sailing is dangerous, by bad weather, squalls, high waves, or other dangers that may suddenly appear, then cunning becomes a matter of great importance; and the care of the superior officer, or who he may appoint, should only be attended to, and answered briskly by the movement of the helm as well as by words, to avoid the danger, or to help to ease the ship to rise and fall gently with the waves; as it is well known to ease a ship much in her labouring motion to luff her up with the helm a lee at the approach of a high steep wave, when sailing close by the wind in a storm. But to suppose a ship sailing two points from the wind, it is a dispute whether it is best that she should be luffed to, or should bear away from a dangerous wave, that may be observed coming right upon the beam.

On sailing and Cunning, with high Winds and Waves right upon the Beam.

THIS way of sailing, in my opinion, deserves particular notice; because it is more exposed to danger and damage than any other way of sailing; for a ship upon a wind, in high waves, is suited with sail accordingly, and has so little head-way upon her, that she may be luffed up to a dangerous wave, and by that made much easier. And when sailing large, a ship runs from the waves and weakens its force upon her. A ship lying to, and driving to leeward, yields and gives some way to a high wave when it strikes her, which may a little abate its bad effect; but when carrying a presssing sail with the wind upon the beam (which is common, because accounted a fair wind) a fast sailing ship is reckoned then to sail fatter through the water than any other way with the same wind, as she does not recede from the wind or waves, and makes little or no lee-way; but this exposes a ship to all the violent effects of dangerous high steep waves, which may strike and break with their utmost velocity upon the broadside to windward, whilst the ship's great head-way through the water makes the greatest resistance to prevent her from yielding or giving the least way to leeward. From this, and the other causes mentioned pages 59, when a ship is lifted up broadside with so quick a motion, from the bottom to the top of a high, steep, mountainous wave, it is not to be wondered at that the ship, men, or materials, may receive great damage at such times. And the

danger of
this way
of sailing.

greater the ship, and the more water she draws, the more liable she is to damage; smaller vessels giving more way to the waves than large ones, when struck. I have been in a small vessel in company with a fifty gun ship that had her mainsail split, and other damage done by the waves breaking on board her, whilst we received none in the small vessel. At another time crossing the western ocean in a light merchant ship, with our guns (which were six pounders) stowed down in the hold upon the ballast for the ease of the ship when sailing this way, a stroke of a wave canted our ballast and guns from the weather to the lee side of the hold, and broke the stanchions that supported the lower deck beams. These and many other instances confirm my opinion of the great danger attending this way of sailing.

On luffing up to, or bearing away from a dangerous wave. On cunning and steering a ship when sailing in this way, it may be disputed whether she should be luffed up to, or bear away from a dangerous high wave approaching upon the beam. Reason as well as experience teaches us that the helm should be put hard a-weather, to bring the approaching waves far aft as possible, to lessen its force, by the ship's running forward and giving the more way from it, rather than to luff up with the helm a lee to meet it with too much sail and head-way upon the ship as must increase the stroke of the wave, and may produce a violent and dangerous pitching motion. I had an instance of this when I was mate of a ship, and it was my watch upon deck. When sailing in this way, at the approach of a dangerous wave coming right upon the beam, I ordered the helm hard a-weather; but my commander ordered the helm a lee; which occasioned the wave to have the above mentioned bad effect; and though we received no material damage; yet, in my opinion, it would have been less hazardous to have bore away with the helm a-weather.

BUT to do justice on this occasion, it must be allowed, that ships in general can nearly carry a pressing sail in this way, and we are apt to gripe and carry the helm nearly hard a-weather, to steer the intended course; so that without this is noticed, and guarded against by the officer of the watch, by having only a suitable sail set, and properly trimmed, it may be out of the power of the helm when hard a-weather, to make the ship wear fast enough to avoid the bad effects of a dangerous wave when perceived to be coming upon the beam.

After all that can be said on this way of sailing, when the waves run high, I look upon the danger so great, that it ought to be avoided

avoided as much as possible; and it may be commendable to alter the course, so as to steer with the wind and waves, either to point before, or abeam the beam; or for a time each way, if the occasion requires that nicely.

ON CARRYING SAIL AGAINST HEAD WAVES.

GREAT caution is necessary on this occasion, to prevent the damage that may be done by it, sometimes even to pitching away the bowsprit, masts, &c. And as the waves, in the open sea, do not immediately cease with the wind that raised them, but often continue to run the same way for a great while after the wind is changed even to the opposite point of the compass; therefore when a sudden change of wind happens, care should be taken not to be too forward in setting or carrying sail, so as to give the ship too much head-way against the old waves, before they are fallen; as it may pitch the bowsprit under water; which I have often seen done to a dangerous degree. Sometimes head-waves will rise against and reach a ship a long time before the wind that raised them, which may make it equally dangerous to press the ship with too much sail against them.

ON LOOSING AND SETTING SAILS.

IN loosing square sails when it blows fresh, it should be a constant rule to loose the lee-yard arm before the weather-yard arm, to prevent the danger that the people to lee-ward are often exposed to, of being thrown from the yard by the sail flying up over their heads. In letting the top-sails or top-gallant-sails upon a wind, when it blows fresh, it is an approved method to haul home the lee sheet first; and if the sail be kept shaking by the weather-brace, the weather sheet may be easily got home; but when flogging large, the weather sheets of these sails are most commonly hauled home first. In setting the mainsail and fore-sail, if the wind requires it, the tacks are hauled down first; but in box-hauling, or wearing, the sheets may be hauled nearly aft, whilst

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ON DRAWING NEAR TO DANGER, &c.

the sails shake with the wind npon the quarter, and the tacks may then be got down very easily.

Now let us suppose, a ship has proceeded so far in her passage, as to draw near to danger, or to make her designed landfall.

On Drawing near to DANGER, or making a LANDFALL.

ON these occasions, it should be considered before hand, what it most depends upon, to keep clear of the danger, or to make a good landfall. If they have regular soundings to it at a great distance, then the lead may be the surest guide; but if it be steep to, without soundings, then the latitude, if it is known, and a good look-out, with the ship properly prepared for it (as mentioned page 116) may contribute greatly towards safety.

WHEN going to cross dangerous latitudes, where projecting points of land or shoals may lie in the way; or in making small islands, such as the Cape de Verd and Canary Islands; it is certainly very wrong to run without much caution in the night, or in thick weather, with a crowd of sail, on presumption that the ship is far enough to the westward to go clear of them, which has occasioned many fatal losses, from being deceived by the constant Easterly current that runs in this track; and which in my opinion is the principal cause that ships so often make more longitude out than they do home, in *West India* voyages, as before mentioned page 146.

It is the latitude only when known by observation, and not the longitude, that can be depended upon for ships being near, or clear of Danger. I was in an *East India* ship outward bound, the Captain of which rather than run the risk of crossing the latitude of one of the Cape de Verd Islands in the night, tack'd ship and stood back to the northward under an easy sail till day-light; when it plainly appeared that if we had continued our course to the southward, we must have run upon the island before day-light.

To make a good landfall, if the situation and circumstances of wind and weather permit, that a ship can sail with a leading wind true East, or West, to the place of the designed landfall, it is an approved method to get into that latitude in good time; and especially homeward bound from the Western Ocean; and to endeavour

endeavour by all possible means to get observations, to make proper allowance for the variation of the compass, lee-way, bad steerage, currents, or tides if known, to keep the ship as near as possible in this designed latitude. When got into the designed latitude, the uncertainty of the longitude makes the distance to be run uncertain: therefore in the day and clear weather, all the sail that is possible with safety should be carried; but in the night or thick weather, if it is thought prudent to run, it should only be with such sails as the officer and people on deck can look round them, and work the ship so as to avoid the danger in whatever manner it may appear.

NOTWITHSTANDING these rules and precautions in landfalls, I have experienced very narrow escapes, both in *America*, and on our own coast, where we are very liable to be deceived by the tides; and in cloudy weather, by taking one place for another. Among many instances, it was my case in a ship from *Leghorn* to *London*, when in a cloudy afternoon we fell in with, and just got a glimpse of the South side of St. Mary's Scilly Island; which, by our reckonings, and an account we had from an outward bound ship, we took for and concluded it to be the Lizard Point which we had seen. Therefore ordered, (as I thought we might with confidence,) to steer a channel course for the night; but our mistaken situation, though in a fair line of direction with our channel course, occasioned the ebb tide (that sets N. W. between Scilly and the Lands End) to take the ship on the starboard bow, which sheer'd us insensibly into the bottom of Mount's Bay: about midnight we were surprised with broken water, and land extending as far as we could see on our starboard bow, when carrying top-gallant-sails with a fresh gale, quartering at S. W. and large swelling waves from the main ocean, right into the bay.

THE hurry we were in to exert our utmost endeavours at this critical moment, may be judged from our dangerous situation: we had our small sails to take in, and our top-sails to get down, before we could bring the ship by the wind, to lay her head from the nearest breakers; and we had the main and fore-top-sails to close reef; and the top-gallant-yards, &c. to get down, when we had not room to stand above a quarter of an hour upon a tack, clear of the breakers. This so alarmed some English passengers (and even one of them who had been brought up to sea) that they all assembled in the great cabbin to prayers, which they thought was their only refuge for safety; but putting the ship in stays, which she refused,

On turning out of Mount's Bay, and how we managed in box-hauling.

refused, and then wearing her round, by box-hauling, as represented in the two figures, plate the 7th, frightened them from prayer, and they all came upon deck, thinking we were running the ship on shore. We thus managed her by box-hauling; and as soon as we perceived the ship ceased from coming about in stays, we hauled the fore sheet close aft again, trimed the head-sails flat whilst the sails were shaking, and hauled about the main and main-top-sail, the same as if the ship had stayed; then hauled up the mizzen and kept the helm hard a lee, as represented by fig. 2, in the same plate; by which the ship getting great stern-way, turned short round upon her heel, till she filled the main and main-top-sails the right way: we then shifted the helm hard a-weather, when the ship got head-way with the sails trimmed, as represented by fig. 1, which brought her readily round, with little loss of ground: and by these means, in about twelve hours we turned to windward so far off the lee shore, as represented fig. 3, and so as to weather the Lizard; where, to prevent such dangers at that place as we then narrowly escaped, they have since erected light houses; for which they have my thanks, and in my opinion deserve the thanks of the public. The like public thanks will be due to whoever may be instrumental in getting a distinguishable light or lights on Holyhead, to prevent as much as possible such fatal losses as have often happened in Canarvon Bay, occasioned principally by the ebb tide taking ships on the larboard bow, in St. George's Channel, when steering from Tusker for Holyhead, and which sheer them insensibly into Carnarvon Bay, if the tide is not properly allowed for as before mentioned.

THAT a ship sailing against a tide or current, which takes her on either bow, is the cause that alters her course, must be evident to every one who knows that when a ship is sailing with a leading wind in a narrow river or channel against a strong tide or current, it requires nice steerage right against the stream, to keep her in a fair way; for if the stream is suffered to take her on the starboard bow, she will soon sheer upon the larboard shore; if on the larboard bow, upon the starboard shore, &c. so that the same cause will have the same effect in all narrow seas, or channels, in proportion to their breadth. Where the tide or current runs strong, it may be highly necessary in the night or thick weather, to endeavour to steer right against the stream, whilst it runs against the ship, as circumstances may require, to keep the ship in mid-channel, or in a fair way till day-light, or until the weather is so clear

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On getting a PILOT on board in bad Weather at SEA.

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as to permit us to see the danger at a sufficient distance to run across the stream, boldly, for the land, to find the ship's real situation ; which may be a means to avoid such dangers as above-mentioned, and to proceed forward with more safety. Proceeding in this cautious manner, is especially necessary in St. George's Channel, where the tides run so strong, that when a ship happens to enter it, at the first part of either flood or ebb, if the land cannot be seen clear enough to make proper remarks, the tide may make vast alteration in the intended distance to be run, as well as in the course ; by which people's judgment is apt to be misled ; and they take one place for another ; which has occasioned great loss and damage, to my knowledge.

THEREFORE after a night's run in St. George's Channel, if the land you happen to fall in with appears dubious, to avoid any bad consequence that may attend a mistake, no pains should be spared to get a certain knowledge of it. At the clearing up of a fog, I have been obliged to send a boat on shore to inquire what land it was that we found ourselves so near to, and was surprized afterwards to find it was a part of the Isle of Man ; and we should not have known it without this trouble : such great alteration does the different state of the atmosphere sometimes make in the appearance of land.

Now let us suppose a ship arrived safe to where she is obliged to take in a pilot : if she is to be boarded from a sloop, schooner, or hoy-rigged vessel, under sail at sea, in bad weather, it may be dangerous, and is often attended with damage, if not properly managed ; therefore it deserves notice.

On getting a PILOT on board in bad Weather at SEA..

THIS is sometimes attended with so much danger, that the Pilots belonging to Liverpool, rather than run the risk of boarding a ship from their own sloop, sometimes go no nearer to the ship than to have a small rope thrown to, or veered a stern, to them, which they make fast about the Pilot's body under his arm-pits ; he then goes overboard into the sea, when as near the ship as they dare venture, and he is hauled on board the ship by the rope.

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IT is a bad and common practice, in many ships, when the Pilot's vessel has got near them, to lay the ship to, with the helm a lee ; and to let her drive with the main or fore-top-sail a-back ; thinking they may be boarded by the Pilot's vessel without danger. But no sensible pilot, that knows what would be the consequence, will offer to board at such time, whilst the ship lies to. But if an unexperienced Pilot boards a ship upon the weather quarter (which seems much the best for the purpose) the ship then heeling to leeward, keeps the yards, masts and rigging clear from getting entangled. Yet it is well known from experience, that it is more difficult to board to windward than to leeward ; and that a stroke by a wave from a small vessel against a large one, will do much more damage, than a stroke by a large vessel against a small one ; because the large vessel resists, and does not give way to the blow of the small one, which small one would yield and give way to a stroke from the large one, in proportion to the difference of their weight : for which reason, a ship should always be boarded on the lee side ; but to do it whilst she lies to, is attended with too much danger to risk, when the ship has any motion from the waves ; for the helm being a lee, the ship may get sternway, and fall round off from the wind, whilst the Pilot's vessel is boarding ; which may occasion great damage ; and for want of a stern rope, I have known rowing boats, when boarding, get a-thwart the hause, and sink at such times.

THE best method for this purpose is, when the Pilot's vessel is got near, (but still far enough to windward) for the ship to fall right forward, about a point from the wind, with the after-yards braced sharp up, the main-yard aback out of the way, and sail enough, especially stay-sails, to keep good head-way upon the ship, the more the better, so that she has only a little less way than the Pilot's vessel, which may shoot up under the ship's lee quarter, where a stern rope, and one passed aft from close forward, should be ready and thrown to them ; by which they may tow and steer their vessel clear from damage under the lee quarter, sheltered by the ship from the waves ; and may watch for a smooth sea, and sheer to the ship, at pleasure, to board the Pilot, and sheer clear again with the least risk possible.

SHIPS should have skilful Pilots, to take care, when among dangerous rocks and shoals, to keep clear of them. A Pilot's qualifications should, as much as possible, be every way equal to the dangers and difficulties that attend his navigation; and he should know where the shoals extend to a great distance; where the channels are narrow, intricate, and shallow; and where and when exposed to dangerous waves, where life, as well as property are at stake. None should be admitted to take upon them this important charge, but such as, from experience and practice, can give a ready verbal account of the course and distance from one place to another; the flowing and setting of the tides; depth of water, land marks, buoys, beacons, lights, &c. And should not only be seamen enough to work and manage a ship to the best advantage in fine weather, but capable, when in difficult situations, to form a right judgment of what is best to be done for safety, and what can reasonably be expected for the people and the ship to do on every occasion.

THE best and most dexterous Pilots for working and managing ships in crowded, narrow, or dangerous channels, are those at *Tinmouth haven*; who, from much practice by having so many large collier ships to pilot in and out, (as mentioned page 129) are more expert than any other people that I have seen; and they take remarkable pains to get the ship steered to their mind; they look out sharp, and call the helmsman loud and quick, and make him answer and move the helm as the occasion may require, to counteract as much as possible any motion of the waves that may make the ship deviate, either way, from her intended track. And when they turn to windward into the harbour, they likewise observe with great attention, and call quick, to keep the ship fairly full, by the wind, with the mainsail let, to make her more sure of staying, and with good way upon her, to make her work the better. And when they come to, where there is not room to turn to windward, they take care to lay her head the right way, brail up the courses, and drive to windward with the tide, even where they have little more room than the ship's length.

BUT when or where a Pilot has found defective in seamanship, or capacity to judge and act with skill and prudence, on difficult or dangerous occasions, it is certainly the duty of the commander and proper officers to be upon their guard, and not to give up their judgment and themselves implicitly to a Pilot, of whose conduct

they have no assurance; which has, to my knowledge, occasioned great damage and fatal losses.

THEREFORE when a Pilot's capacity is not known, his behaviour, in management and design of proceeding, should be noticed; and he should be treated with more or less confidence, as his conduct seems to deserve. And when it plainly appears that his conduct cannot be depended upon, then self-preservation, the first law of nature, makes it a case of necessity and point of duty for the commander to interfere with the Pilot, and to trust to his conduct no farther than is consistent with safety. He should not be afraid of that false common notion, that if a commander of a ship interferes in the Pilot's duty, he makes himself answerable for the consequence of the insurers: it is quite otherwise; for the insurers insure the commander's conduct; therefore, instead of being blamed by the insurers, he certainly deserves their thanks for endeavouring to prevent loss or damage likely to be occasioned by the thoughtless blundering Pilot who has fallen to his lot; which has been my case, and we had a very narrow escape.

BUT Pilots, like other ranks of men, must be allowed to have different capacities and dispositions; and according to their practice they must be more or less capable of their duty; consequently, among the many, there must be a variety of good, bad, and indifferent. Yet the respectable character of a Pilot on the whole, entitles them to be treated with all the regard and encouragement their usefulness deserves. When a Pilot proves deficient in his duty, and a better is not to be had, it is certainly best to make the most of him, and to endeavour by all possible means, to help and advise with him, with temper and candour, what may be thought best to be done according to circumstances: and if his spirits appear to fail him in a dangerous passage or situation, and no remedy left but to go forward, he should then be cheered and encouraged to keep up his heart, and not to let fear, nor intoxication with liquor, get the better of him, which may be equally of bad consequence.

BUT the most danger is from those inconsiderate and unexperienced Pilots, who suppose a ship may be managed and conducted with equal ease and safety among shoals, as their own small vessels to which they have been accustomed; therefore, they think there is no occasion to wait for the tide, the day-light, or clear weather, but to push forward at all hazard, though it may be such weather that no lights, marks, buoys, or beacons can be seen, not

nor dangerous shoals guarded against, by a compass course, nor by the lead, at a sufficient distance to keep clear of them.

I HAD the experience of a Pilot of this sort, who wanted to run in the night amongst the shoals, when nothing could be seen for a guide to keep clear of them ; therefore I opposed him till day-light ; when it blew fresh, right upon the shore ; with drizzling, hazy weather, so that we could not see a mile before us : he pressed me very hard to bear away and set sail : I reasoned with him of the danger ; and would not consent till we had a consultation of the officers. He was told of the great risk there was in running upon a lee-shore in such bad weather, and that if we fell in at any great distance from a fair way, he was to consider that the ship was not to be worked and managed in little room among shoals, like the small vessel we had taken him from, &c. He answered ; " that the greatest danger was from not running to get " into safety when we might ; and that his life was as dear to him " (having a family depending upon it) as any of ours could be to " us ; and that if he could but see any part of the land, or even " the breakers, he could steer in by them, to get into safety."

By the Pilot's persuasion, we bore away for our port ; but with all the necessary precaution possible, to guard against the apprehended dangers above mentioned. We ran before the wind under close reefed main and fore-top-sails, thinking we should be obliged to carry them by the wind, if occasion required to make the ship work, or to keep clear of the lee-shore ; the lower sails in the brails, being ready to set on either tack by the wind ; the anchors and cables all clear ; all hands at their stations, looking sharp out ; and the deep-sea lead going. In fifteen fathom water, we saw land, and shoal broken water, near a head, which were shewn to the Pilot, asking him which way we should go now ? He pointed from the danger we were nearest to ; but looking the way he pointed, nothing could be seen but broken raging waves ; we asked him what was then to be done, being in five fathom water : I perceived he was overcome with fear, and had nothing to say, but left us to save ourselves as we could. We then brought the ship round by the wind, and notwithstanding we were well manned, were obliged to get the main and fore sheet aft, with the tacks not above two thirds down ; by which, under Providence, and the ship's fast sailing, we but just cleared the breakers on the lee-shore ; which would by all appearance have proved our total destruction, if the ship had been left to the conduct of the Pilot, who

who after this, as it is common with all such unthinking men, went, from a rash confidence, to such extreme fearfulness, that he thought we could not possibly get far enough from the danger we had so narrowly escaped; so that when the weather cleared up, with a sudden change, and a gale of wind right off shore, that put us under reefed courses, we could but just see the land from the mast head.

THIS Pilot's conduct; and the many instances of damage, and fatal losses that have been occasioned by rash, imprudent, and defective Pilots; prove the necessity that a commander may be often under, to interfere with the Pilot; but it should always be done in a calm friendly manner, to advise and assist him in whatever he may seem deficient. It is but reasonable to suppose that a commander should know the trim and properties of his ship from experience, and what dependence may be put on her for sailing, steering, staying, waring, or riding at anchor, &c. as also how to work and manage her on extraordinary occasions, in narrow and dangerous channels; and should form a better judgment what his ship and crew can do, than a strange Pilot who may be a clever man, and know his business as a Pilot very well; yet, for want of such experience, may be much inferior to the commander in working and managing the ship; and when this is the case, it should be agreed, for the Pilot to shew the way and point out the dangers, whilst the commander works and manages the ship to keep clear of them; which, in my opinion, may often contribute greatly to prevent misfortunes. But when a Pilot is known to be thoroughly qualified to work and manage a ship as the navigation requires, then the commander has only to see that the Pilot's orders are obeyed.

WHEN ships are going for shoal flats, bar, or tide harbours, where safety depends upon the height and time of tide, (which makes all hints or remarks from observations on the tides deserve special notice) I will venture to give some observations upon them.

ON THE TIDES.

THE tides, and the knowledge of them, are of such great and important advantages to our navigation, and especially among our many shoals, flats, bar and tide harbours, where it depends

depends entirely upon the certainty of the flow and time of the tide to proceed with safety, that our utmost endeavours should be used to obtain the best knowledge of the tides that is possible, in all our tide and bar harbours that lie near the sea, by observing and remarking the time, and how much they flow on an average, not only at full and change, but at the quarters of the moon, which is the time that the tides are at their greatest deviation from the mean and common way of reckoning them: which, if made public, might contribute greatly to come at a more perfect theory of the tides, as well as prevent the loss and damage that may be occasioned by ships running for our shoal water harbours at a wrong time of tide, and being deceived by the old common method of reckoning the tides; which is very erroneous; especially at the quarters of the moon. Marking the time of flowing, at full and change, always to a point of the compass, adds to the uncertainty of a ship from sea finding the time of high water, and ^{Damage} which from experience I can say has occasioned great loss and ^{done by} running ^{at a} ^{wrong} ^{time of} ^{tide.}

I was in a *West India* ship, running for a bar harbour in *Ireland*, by this erroneous rule; when, we beat off our gripe, rudder, and a great deal of the stern-post and after part of the keel, upon the bar; and had seven feet water in the hold, when we got into the harbour; and were obliged to run on shore to prevent sinking. At *Liverpool*, I have observed ships coming in, at neap tides, about the quarters of the moon; when, instead of meeting with high water, as expected by the common way of reckoning, they have found it about a quarter ebb; so that for want of water enough, they have often struck, or come aground, and lain upon the bar, when loss or great damage has often been the consequence.

For these reasons, and at the request of my friend Mr. *Ferguson*, the Astronomer, who with great labour and pains furnished me with large schemes, tables, plans, &c. relating to the tides in the year 1764, I began, and have continued to make observations on the time and heights of the tides flowing at the old dock gates, in *Liverpool*, which is about three miles from the mouth of the river, and the river so broad and extensive, that as a branch of the sea, no land floods or freshes have any effect on the heights of the tides in the river, opposite to the town; and where the least flow of water, that I have observed in neap tides, was nine feet at the dock gates, when low water was just even with the sill of the gates, from whence are marks in the stone work, upward, 22 feet and

OBSERVATIONS ON THE TIDES AT LIVERPOOL.

and a half; from which the heights of the tides are taken; but although there are no marks below the fill of the gates towards the river, yet from observations made on the whole rise on some tides, I have reason to conclude, that in moderate weather, in proportion as the tides commonly rise above the ninth feet mark at the gates, they fall below the fill of the gates; and that the four feet and a half mark is near the half flood mark, let the rise be what it will, though it does not agree with half the time of flowing or ebbing of the tides.

BUT to observe more exactly the whole rise of one of our middling tides, I had a board fixed upright at low water in the river, marked with six inch marks, each foot, and high enough to observe by, till the tide reached the dock gates; and then remarked the time it flowed to each foot the rise of the whole tide, which was 22 feet and a half, from seven feet below the dock gates, to the 15 feet and a half mark at the gates, in five hours fifty minutes. The first half tide rose in two hours forty minutes; but the next to high water was three hours ten minutes: so that the first half tide rose in fifteen minutes less time than the last; and it fell again to the half flood mark in about fifteen minutes less time than it was in rising. But the slack tide at low and high water, must be allowed to account for part of these irregularities. It ebbed the tide before, (as I judge it does most commonly in moderate weather) six hours thirty minutes; which, added to the flood, five hours fifty minutes, makes twelve hour twenty minutes. The twenty minutes difference in time between these two high waters, agrees with a tide table that is calculated and published here yearly by Messrs. Holdens: the benefit of which will be mentioned hereafter.

Shape of
the waves
of the tide.

I HAD the above tide drawn into a scheme, dividing the feet the water rose and fell, by the minutes of time. The wave of the tide, as it may be called, formed a curve near the parabolic, or the range of a bomb shell (only spread out at the bottom) as the first and last half foot in flowing took about thirty minutes, varying by degrees faster and slower to half tide; when, it flowed the fastest, a foot in about ten minutes of time.

The tides
flowing
compared
with a
tide clock.

THE old method of reckoning the tides, by mean or equal difference of time, or the bearing of the moon by the compass, from full to change, has been found very defective. I had a tide clock made, that was planned by Mr. Ferguson, to shew the time of tide by this rule. I kept the clock going as near as I could do to solar time; and what proved very remarkable, was, that at the quarters

quarters of the moon, when it was really high water by the tide, the clock commonly shewed only three quarters flood; so that, from the full and change, to the quarters of the moon, the time of high water commonly lost near a quarter of a flood, or above an hour from regular time.

MANY laudible attempts have been made to fix easy rules to agree with the deviations abovementioned; which, it must be allowed, would be a great improvement in reckoning the tides: yet I have learned from experience and observation, that, to come near the truth, nothing less will answer than calculating the attractive powers of the moon and sun, according to their distances and situations from us; which makes a great difference, and brings on both spring and neap tides sooner or later, and alters their heights, as well as the times of high water. Even at full and change of the moon (the only stated times) they will vary fifteen minutes, though all proper allowances may be made of two minutes of time for every hour the full or change happens to differ from the stated time of high water.

As we move round the sun, and the moon round us, in elliptical orbits; and as the moon's motion is faster or slower as she is nearer or farther from us, (which is reckoned to be about 34,000 miles nearer to us when in her perigee, than when in her apogee, and thirteen days and a half in going from one to the other) that makes the high and low tides constantly vary accordingly; and this seems to me to make about a sixth part difference in the height of the tides from what they may flow in common; which I reckon to be about twenty eight feet, the whole flow of our common spring tides, when we have about eighteen feet at the abovementioned dock gates: but when the moon happens to be in her perigee at full or change and great northern declination, then we have about twenty one feet at the gates. When this happens at the quarters of the moon, instead of twelve feet, as is common at neap tides, we have about fourteen feet at the gates. And when it happens at equinoctial spring tides, we have about twenty two feet at the gates; and the neap tides are low in proportion, if the moon happens to be in her apogee. And what is very remarkable, that from about the tenth of May to the tenth of November, the night tides that flow from six in the evening to six in the morning, run the highest; and from the tenth of November to about the tenth of May, the day tides run the highest; and this difference often amounts to eighteen inches.

A a

WHEN

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nation

When the
day and
night
tides run
highest.

Why the
spring
and neap
tides
come
sooner or
later.

WHEN the moon happens to be in her perigee, at the quarters, it makes high neap tides, as before observed; the spring tides following, put up early; and the highest tide is often on the full or change day. But when the moon happens to be in her apogee, at the quarters, the following spring tides are late in putting up, and are not at the height till the third or fourth day after the full or change; and all the other intermediate tides are influenced in the same manner, according to the moon's distance and situation, and as she is going farther from, or coming nearer to us, in her orbit; all which deserve notice on many occasions; especially when there may be a doubt of a ship's having water enough to answer her purpose.

The pro-
gressive
difference
of the
time of
the tides
flowing.

THE times of the tides flowing, and the progressive difference of time between one high water and another, are likewise obedient to the laws of the same powers. For when the moon happens to be in her apogee at the full or change, then her motion in her orbit is slowest; so that for five or six tides, afterwards, the progressive difference of time between one tide and another is only about fifteen minuets, till they lose about an hour from equal time; then they alter nearly to equal progressive time of twenty five minutes, each tide, to the quarters, when they flow about four o'clock, whether the quarters are long or short, almost as near a stated time as they flow about eleven o'clock at full and change. After the quarters of the moon, the progressive time of flowing begins to increase forty five minutes each tide, till they fetch up the lost hour, and come up to equal time about six tides before the full or change; which six tides only agree near with the abovementioned tide clock, differing each tide about twenty five minutes till the full or change, when they begin to make their deviations again as above described.

Holden's
Tables
for the
time and
height of
the tide's
flowing.

BUT the ingenious mathematicians Messrs. Richard and George Holden, from observations here, and some at Bristol, have formed a theory and accurate method, whereby they calculate and publish yearly tide tables, to shew not only the time, but the height of the tides flowing at Liverpool old dock gates, which I can say from experience agree surprizingly near to observations. Therefore I take the liberty to give the principal part of the preface to the tide table for 1773.

"A PERFECT theory of the tides, and an accurate method of calculating them, has been greatly wanted in every age since navigation was first practised; and, though industriously sought

"after

" after, has hitherto baffled the researches of the most learned.
 " And as their theory has hitherto remained defective, so their
 " methods of calculation, founded thereupon, have succeeded no
 " better; for, as I am now furnished with about 3000 observa-
 " tions made upon the tides at *Liverpool*, and 360 at *Bristol*, with
 " which I can compare my own, and all other methods of cal-
 " culation, I think I may venture to assert, that all the methods
 " given us in books of navigation, and all the tide tables inserted
 " in our almanacks, are very frequently subject to the error of an
 " hour, and many times as much more; except that of *Monsieur*
de la Caille, which yet is often liable to an error of forty minutes,
 " as any person will find who takes the trouble of making a
 " sufficient number of observations.

" INDEED no person can expect it should be otherwise, who
 " considers that *Monsieur de la Caille's*, and all other methods (ex-
 " cept that of *Monsieur Cassini*, which in truth is no better)
 " depend entirely upon the moon's age, or her distance from the
 " sun; without regarding the different distances of either the sun
 " or moon from the earth, their declinations, the latitudes of
 " places, or any thing else that affects the tides.

" THUS deficient are all former methods in computing only the
 " times of high water; as for the heights, the calculation thereof
 " has never before been attempted by any one, that I know of;
 " though they are, as I apprehend, equally necessary; for of what
 " advantage can it be to the seaman, to know when the tide, will
 " be at the highest, if there will not be, at that time, depth of
 " water sufficient for his purpose? Indeed it would be of no more
 " service to know that there would be depth enough of water,
 " unless he knew at the same time, when to expect it. But to
 " know what height the tide will rise to, and at what time, must
 " contribute greatly to his security: and is it not absolutely
 " requisite, that a tide table should inform him of both these?

" IF any person should think proper to compare this table with
 " his own observations, he ought always to set his watch right im-
 " mediately before, by some good sun dial; for these calculations
 " are made according to solar time.

" AND if the watch can be thus truly regulated, I doubt not
 " but that they will be found to correspond very nearly with the
 " observations, as this table is composed with the same care and
 " exactness as the last, I having had the assistance of Mr. *Bryan*
Waller, through the whole work.

" INDEED it cannot rationally be expected that any method of computation can perfectly agree with the tides, because they are subject to various alterations from the wind. Yet notwithstanding all the irregularities caused thereby, the heights given in the last tide table, have agreed with the observations (upon an average) within seven inches; and the times within five minutes."

GEORGE HOLDEN.

Advantages of
their tide
tables.

NOTWITHSTANDING gales of wind affect the tides, I observe it is more in height than in time, that they are made to differ from these tide tables; and then an allowance may be judged of according to the strength or velocity of the wind blowing for or against the course of the flood tide (which here blows from the south west quarter) and, which we may suppose, may increase the height of this tide above the theory, about an inch for every mile of the wind's velocity above a fresh breeze of about ten miles an hour; and may decrease the height in proportion as the wind blows from the North East quarter.

So that these tide tables must certainly be of great utility to all that are concerned in the time and height of the tides flowing; and from their height, may judge of their velocity, which, I reckon, opposite to the town, is at the rate of about a mile an hour for every fathom it flows up and down, and that is about two and a half at common neap, and about four and a half at common spring tides; and there is seven feet more water on the bar of the common channel, than at the old dock gates, and about twelve feet water at half tide, at all tides, both neap and spring tides; so that by the tide table, it may be judged when ships will have water enough to get into the river, and into the dock with safety: as also how to birth them according to their draught of water, not only in the wet docks, but in the graving or repairing docks; which are of different depths, that they may have water enough to get out as well as in. And the tide table is thought to be of that importance to our Pilots, that the laws for regulating the Pilots, make it a penalty of five pounds for a Pilot being without a tide table, and a watch kept to solar time.

I HOPE therefore these tide tables will meet with all the encouragement, that the author's ingenuity and labour deserve, to continue their publication, till time gives them a fair trial how near their theory agrees with our shoally, dangerous ports or places, the safe navigation of which depends upon knowing the certainty of

of the time and heights of the tides flowing; which may be a means to recommend such tide tables to be tried and used in proportion to the advantages that may be experienced from them. But till time brings this about, the only method to judge when the tides will be higher or lower than common, is, to attend to the moon's distance, being near her perigee, or apogee, and declination, (as before mentioned) which are remarked in the nautical or *White's* almanacks; and should be in all our navigation books; where the flowing of the tides are remarked. We should make an allowance, when a storm of wind happens to blow near to or against the direction of the flood tide; which I have observed to make an alteration of about three feet in the height of the tides, when I judged the wind to be blowing at the rate of about forty-five miles an hour. I cannot perceive, as has been imagined, that the tides are affected when our neighbouring worlds are passing near us on the same side of our orbits, as mentioned in page 121; or by the different weight of our atmosphere, as shewn by the barometer. And as I live fronting, and but fourteen yards from the dock gates abovementioned, (which open with the flood, and shut at high water) whilst I am able to pursue such inquiries, should be glad of any direction, rules or hints, that might improve observations on the tides, to make them more useful to seamen, Pilots, Mathematicians, Astronomers, or Philosophers.

On Ripplings or Races that run at the Edge of strong Tides.

THESSE waves rise perpendicularly, very quick; and run in a confused manner, in all directions; and fall with so swift a motion up and down, as make, in some measure, temporary vacuums in the air, that interrupt the natural course of the wind; which keeps a ship the longer among these tumultuous waves, that toss her about with such violent, confused, distressful motions, as immediately to stop her way through the water, and prevent the power and action of the helm; and though there may be a fresh of wind yet make the sails flap to the masts, the ship does little more than drive along with the race of the tide. These races, therefore should, as much as possible, be avoided, as dangerous; especially to open vessels; and as I have experienced, in passing one in a schooner rigged vessel, when we shipped so much water as nearly

On a SHIP at ANCHOR waiting for the TIDE.

nearly to sink us before we got through it. But, when a vessel *must* pass them, it is best to do it with the wind large, to get the sooner through. I knew a ship of 300 tons, that fell into one, off the island of *Ushant*; by which they had their two boats washed off the deck, and lost; and which did a great deal of other material damage.

On a SHIP at ANCHOR waiting for the TIDE.

WHEN a ship lies near shoals she is to pass or go over, I have known great advantages in observing the shoals at low water, and the flowing of the tide by the lead; and by comparing these with the ship's draught of water, they will help to form a judgment when a ship will have water enough.

WHERE different remarkable objects and marks can be seen and distinguished as the tide flows up to them, and that may correspond or compare with the height of water on the bar or shoal that the ship is to go over, they should be remarked in the draught of the place; as may be seen in the instructions at the bottom of the chart of the bay and harbour of *Liverpool*; where there are eight different remarks for that purpose: but the best method is, where distinct signals are made by colours, or lights, on shore.

ANOTHER remark, from observation, on the tides, deserves particular notice here; that although the high and low water marks are always varying, yet the half-tide-mark, three hours before and after high water, is very near the same, when we have about twelve feet water over the shoalest part of our bar, in a fair way, in coming to *Liverpool*, in neap as well as spring tides.

On Buoys, Land-Marks, and Light-Houses, to avoid Dangers.

THE real advantages and disadvantages attending these important objects, cannot be known but by observations, to make fair comparisons and improvements of them.

TH E lighter and cheaper they can be made and laid down, to answer their important purposes, the better.

To begin with the *Stones* to which the buoys are moored. Instead of a large iron bolt, going quite through them, we only fix *Lewises* in them, such as are used in hoisting up large stones for buildings, run in with lead. The chains, for sake of lightness, we make of a long eye-bolt-link of eighteen inches, and a short oval link of six inches, alternately. And the buoys, instead of being all made in the shape of *Can-buoys*, with wood battens and long heavy iron straps from the collar across the broad end, (which makes them ride heavy and deep, and in case of any of the hoops, &c. giving way, the buoy must be stripped from end to end) they are now found to ride much easier, lighter and more buoyant, by having only a short strong eye-bolt of about eighteen inches long, through a solid piece of wood, formed like a cone, or conical cap, made like a dovetail, to fit exactly a deep chine of nine inches, made for the purpose, at the small end of the buoy; which is found sufficiently strong, not only to ride with, but to bear ships getting foul without injuring them, or their giving way. And as ships have been often lost by going on the wrong side of buoys, they may be much better distinguished from each other by the shape of their upper ends, than by different colours.

THE THEREFORE, suppose it was made a rule in going to all ports, to have *Can-ended-buoys*, to be placed on the *starboard* hand, and *Cask-ended-buoys* on the *larboard* hand; which varieties, I can say from experience, may be perceived at a good distance; not only from the shape of the buoys, but, the Can-boy, from its broad, heavy end, swims mostly upon its side; while the Cask-ended-buoy, being so much narrower and lighter at its upper end, swims much more upright and buoyant in the water; which will direct on which hand they ought to be passed for safety.

We have also small buoys about three feet long, with small stones and chains in proportion, shaped as above, called shifting buoys; to be laid and shifted to dangerous shifting spits of sand that come a dry, and as other occasions may require. As to distinguishing buoys by the colours of black and white; I think these colours are difficult and very uncertain to be perceived in the different states of our air; and white buoys are bad to be seen among broken waves. From many trials I have made of all the principal

principal colours, *red* is the most striking, and best to be seen on *Buoys*, as well as *Land-Marks*.

ON LAND-MARKS AND LIGHT-HOUSES.

THOSE that are for leading marks to avoid dangers, and to be erected near the sea shore for this important purpose only, should be made to differ as much as possible in appearance from other common buildings. And if there are Charts of the place, their likenesses should not only be laid down in miniature, in their real situations, with compass lines of direction leading to them ; but also in large figures, with their heights in feet, in vacant parts of the Charts ; that strangers may know them, and their intended purpose the better ; as is done in our Charts of *Liverpool* ; and where the fronts of the *land-marks*, towards the channels, are painted *black*, *red* and *white*, in large divisions, that they may be the more surely distinguished in the different states of the atmosphere and weather.

ON LIGHT-HOUSES IN GENERAL.

AS many valuable lives, and great property, often depend upon the certainty of seeing these lights, at a sufficient and proper distance, no pains or expence should be spared to make them as perfect as possible, to answer their designed purpose ; especially where there is a sufficient fund allowed to support them ; or where the increase of trade or shipping make large profits arise from them. It well deserves the attention of the public, to get our light-houses improved upon the best plan, for the greater safety to shipping, and consequent advantages to all concerned therein.

IT is well known, from reason as well as experience, that an open coal fire light, exposed to all winds and weathers, cannot be made to burn and show a constant steady blaze to be seen at a sufficient distance with any certainty ; for in storms of wind, when lights are most wanted, these open fires are made to burn furiously, and very soon away, so as to melt the very iron work about the grate ;

Uncer-
tainty of
open fire
lights.

grate ; and in cold weather, when it snows, hails, or rains hard, the keepers of the lights, not caring to expose themselves to the bad weather, are apt to neglect the fire till it is too low, and then throw on a large quantity of coals at once, which darkens the light for a time, and till the fire burns up again ; and in some weathers it must be difficult to make them burn with any brightness. And when they are inclosed in a glazed close light-house, they are apt to smoke the windows greatly, nor do they afford so constant a blaze as oil lamps, with reflectors behind them, which we have adopted at *Liverpool*.

ON LIGHT-HOUSES, with OIL LAMPS, and REFLECTORS.

IT is well known from experience that our common street lamps, when the oil is good, will burn a long winter's night of ^{Advantages of lamp lights.} sixteen hours, without any attendance, and consume but very little wick ; which plainly proves them the most certain, constant, steady and uniform lights, that can be used in light-houses, to direct shipping in their passage through dangerous and narrow channels, as at *Liverpool* ; which being situated in a deep, dangerous bay, with shoal land banks at a great distance from the shore (as may be seen by the Chart) lies open and exposed to the most current storms of westerly winds, and to strong tides, which raise high and dangerous waves ; and which occasioned many great and fatal losses before the year 1763 ; at which time four light-houses were erected ; two large ones, called the sea lights, leading through the channel out to, and in from sea, till the two lesser *Hoylake* lights are brought in a line that leads into a very good road-stead to lie in, till it is a proper time and tide to proceed to *Liverpool* ; as may be seen by the Chart. The losses have been very few in comparison to what they were before these light-houses were built ; which prove their great use to the trade of this place for safety as well as expedition, in getting out and in by them. They are built from twenty five to one hundred and one feet high, as the situations and necessity required ; two of them being a great height above the level of the sea, as the curvature of our globe requires, according to the rules laid down in several of our navigation books, which should always be in proportion to the distance of the shoals from the light-houses, which should be so high as to appear and

be seen above the horizon from a ship's deck at a sufficient distance without the shoals, so that her situation may be known by the lights being open or nearly in a line, either to run in, or to get and keep the ship off by them in a fair way, as the occasion of time and tide may require.

Lamps & reflectors, how made and fixed. THESE lamps, and reflectors, as represented in plate 10, fig. 1 and 2, are fixed in the *light-room*, right fronting the channel, or line of direction for a fair way, and opposite the middle of the window, which is high enough in proportion to the reflector, and extends in width, each way, as far as the light can, or may require to be seen.

THESE reflectors are made, as near as can be, to the parabolic curve ; thus : draw a set of parallel lines right across the focus or center line ; mark the focal distance above the parallel lines, and take an extent from the focal distance, to each parallel line, one after the other ; with these extents, mark each parallel line in its turn, from the focus or burning point, with dots on each side of the focus line, to the extent of the designed diameter, and make a regular sweep from dot to dot, as represented in plate 10, fig. 3 ; by which method a form may be made, for the curve of a parabolic reflector of any focus or diameter, to have the property, when the sun's, or any other ray of light or fire come upon them in parallel lines they are reflected to, and cross each other at the focus ; which makes the focus the burning point ; and just the contrary effect takes place, when a burning blaze of fire or light is fixed in their focus, all the rays of light that fall upon them are reflected right forward in parallel lines, with more or less power in proportion to the lustre or brightness of the reflectors, which are illuminated so as to look like a blaze as big as the reflectors themselves, to people in that quarter nearly facing their axes, by the angle of reflection being equal to the angle of incidence.

WE have made, and in use here, at *Liverpool*, reflectors of one, two, and three feet focus ; and three, five and a half, seven and a half, and twelve feet diameter ; the three smallest being made of tin plates, soldered together ; and the largest of wood, covered with plates of looking glass, shaped as represented by fig. 1 and 2, plate 10, and fixed as near as can be to the abovementioned rules : the lamp or cistern part is of copper, for the oil and wick behind the reflector, so that nothing stands before the reflector, to intercept the blaze from acting upon it, but the tube that goes through it, with a spreading burning mouth-piece, to spread the blaze of the lamp parallel to the

the middle of it, just in the focus or burning point of the reflector, as may be seen by the figures abovementioned.

We have a feeding-can, with oil, to stand upon the cistern of each lamp, to supply the consumption of oil, and to keep it near to the level of the mouth of the lamp, near which is a little rim, to prevent any drains of oil along the tube to the reflector (as may be seen in fig. 2,) which drops from the rim into a dripping pan that stands below the reflector; and if the cock of the feeding-can be turned to run too fast, to prevent an overflow of oil, there is a small hole, and a tube in the cistern, that lets the oil into a tin can standing below it. The lamps, like the reflectors, are proportional in their bigness, to make a greater or less blaze, as the distance, at which they are to be seen, requires; their spreading burning parts are from three to twelve, and fourteen inches; which makes the blaze the same breadth, and burns higher or lower, according to the quality of the oil, on which the goodness of the lights greatly depends. The wick is common cotton thread, spun for the purpose of lamps, and wound in lengths to fill the mouth of the lamps about a quarter of an inch thick; and, as it consumes, there are long mouth-pincers, adapted to the lengths of the wicks, to haul out the wicks through the tubes, as the occasion requires: they are snuffed with a pair of sheers in one hand, whilst a tin box is held, with a little water in it, in the other, to receive the snuffings, and prevent the danger of fire; and they require to be attended and trimmed by their keepers, every three hours.

THESE light-houses, constructed, kept, and situated as above-mentioned, have stood the test of a fair trial; and great preference and advantages have been allowed them, even by their opposers; for such there always will be to new things; commonly calling them new whims; till time and trial confirm them useful improvements; which these are confessed to be by all that have seen them; for in a dark clear night, the two sea lights (notwithstanding their height, and the curvature or roundness of the sea, as before mentioned, may be plainly seen when they are in a line with the horizon, not only from the deck, but from the mast head of a ship, which gives the advantage to see which way they are open, to bring them in a line in good time, either to keep the ship off, or to run by them in a fair way, as the circumstances of the time and tide, prudently considered, may require.

BUT it may be said, that these reflecting lights only suit such places as require them to be seen only from *one quarter* of the

compass; which must be acknowledged, though two of our lamps give a blaze twelve and fourteen inches square, and there is but little reflected light above three points of the compass each way; but then, it must be allowed, that the blaze of the lamps can be seen as in common with other lights, above *half* the compass, clear of the edge of the reflectors, which will illuminate the atmosphere fronting them, so as to add greatly to the light, even in that situation.

Light-houses requiring to be seen more than half round.

A LIGHT-HOUSE that may require to be seen above one half, or $\frac{3}{4}$ ths of the compass, may be fixed, upon this plan, with two or three reflectors; one to face each quarter; and to have the tubes for the lamps from one cistern; or to serve a parcel of small lamps, with reflectors of four inch focus, and eleven inch diameter; as represented in plate 10, fig. 4, 5: which may be set upon shelves in rows very near the window; the upper row nearest; and those below, a little behind, to prevent those below from smoking those above them: by such means the rays of light that would go towards the land or against a dead wall, where they are not wanted, are reflected forward to add to the light that goes towards the shipping, for which they are designed.

BUT where a light-house requires to be seen equally from all quarters quite round the compass, and lighted with a number of candles, or common lamps; (as it is known from experience, that rays of light pass and cross each other freely in all directions, without any visible interruption; (it becomes a disputed point, whether reflectors, would be of any service. In my opinion a number of those hand lamps, with reflectors set round upon shelves near the windows, as abovementioned, would reflect many rays of light in a horizontal direction, clear of the smoke, that would fall above and below the windows, and throw more light through the windows, with, than without the reflectors, from an equal quantity of lights; but the advantage that would be gained, wants to be confirmed by experiment.*

On hand lamps and reflectors.

THESE hand lamps and reflectors were contrived to make night signals by lights, to be set in the staircase windows of our upper sea-light-house, that fronts towards the town, in case of any vessel being perceived in distress in the night, or when it is too

Signals for ships seen off, and in distress.

* THERE has lately been a Light-house erected upon the small rocks at the South entrance of St. George's channel, designed to be seen all round the compass; with the oil cistern in the center, that supplies four reflectors of 5 and a half feet diameter as represented figure 1, plate the 10th, and has the report of being a good Light-house and being seen all round, though the reflectors only front the four quarters.

dark

dark to see the day signals, which are represented with the light-house, fig. 6, plate 10, as they are printed upon cards to make them known; and as they have given general satisfaction since they have been in use, and afford information of a greater number and variety of different vessels than any other set of signals I have seen, I thought they deserved this notice. Besides these public signals, several merchants have flag staffs erected at a little distance from the light house; so that when their ships appear with their own particular signals, their colours are hoisted on their flag staffs, for their information.

THE situation of this light-house is well adapted to answer all these purposes, from standing fronting the town and docks, at three miles distance, upon a hill about 40 yards high above the level of the sea at high water; which makes it very conspicuous both from the town and at sea; it being the first object that appears on shore above the horizon, in a fair direction for this channel, as may be seen by the chart.

BUT to return to the hand-lamps and reflectors, as before-mentioned. I tried one of them with our reflectors of three feet diameter, and one foot focus, made and glazed as represented in fig. 1, 2, but it proved greatly inferior, though it might be seen at nine or ten miles distance; and on trying them with a common shop lamp, with equal wicks, and set in different windows of the stair-case of the light-house that faces the town as abovementioned, I found the reflected lamp eclipsed the common lamp to such a degree that I could see it, without using a spy-glass, at three miles distance. These small reflectors were only beat out of common tin; but if they were improved and made of blown quick silvered glass, silver plated copper, or reflecting telescope metal, as concave mirrors, and soldered all together with the lamp in a tin pan like a dripping-pan, (as represented in fig. 4 and 5) only with the addition of tin stays behind the reflectors, to keep all together in handing them about; it is a doubt with me, whether a number, set as abovementioned, would not be preferable to our large reflectors; for I have perceived from experience, that our large reflectors of one foot focus, and three feet diameter, reflect a stronger light, in proportion, than our large reflector of twelve feet diameter and three feet focus. For the quantity of light received upon any given surface, will decrease in the same proportion as the square root of the distance from the luminous body is increased, four, eight, and sixteen times less, &c. There are

from,

from all my experience and observations, I would recommend small reflectors of 11 inches diameter and 4 inch focus, made with what is now called *Mudge's* reflecting telescope metal, as published in the Philosophical Transactions, December 1777; by which I got one made and compared with one of the size and focus, in a nice manner, glazed with six sided quick silver glass, which the metal one greatly surpassed in fair trials. And these two small reflectors have been in use for some time, at a house built on the Point of Linas, on the island of Anglesea, for our Liverpool Pilot's station, who give a good report of it.

Experiment of
the distance
of two lights
not to appear
as one.

ANOTHER great benefit I thought might rise from these hand reflectors if they were brought to perfection; which was, that single light-houses might be distinguished one from another, by having different numbers of windows illuminated by them; but in trying experiments with two of them, set in the first and second staircase windows of the light-house already mentioned, fig. 6, they appeared, at three miles distance, only as one light, though they were above ten feet asunder; and they required to be set in the first and third windows, which are above nineteen feet asunder, to appear as two distinct lights, at three miles distance: which shews how much these imperfect hand reflectors illuminated the atmosphere, and how necessary are experiments before new designs of this kind are put in execution.

IN light-houses, where reflectors are designed to be used, and the lights required to be seen at the greatest distance possible, according to their high and low situation above the level of the sea, the reflectors should be made to stand with their axes, or centers, pointing to the horizon; but where they are only required to be seen at a small distance to lead over a bar, or through a channel near them, then the reflectors should be pointed to the most necessary or most dangerous place; by which means the most rays of light are reflected to where they are most wanted. And from experience we find, that plate ground glass answers much the best, both for reflectors, and the light-room windows: and the larger panes, and the less wood in the window frames to obstruct the light, the better; and the windows that are framed round or circular, as well as the light-houses, stand and resist the wind much better than those that are made flat by the octagon or eight sided form. And to keep light-rooms as clear of smoke as possible, I would recommend a large opening in the centre of the conical roof, with a nice cover, and a large vane to make it traverse freely with

Windows
made
round,
and with
the best
glass, re-
commend
ed.

with the wind; the spindle to be fixed to what is called the dragon, with its point through a collar into a socket below it: for to withhold whatever contrivance, or the best materials that can make them most perfect, as far as their fund which is to support them will afford, should be looked upon as an act of great villainy, for the reasons given.

EXPERIENCE makes another remark here necessary; that without there is a small vacuity made in the walls of light-houses, for the wet to drain down, it will beat through, and rot the wood work.

ON IMPROVED LAMPS FOR REFLECTORS.

IT is a plain and obvious fact with respect to reflected light, that the strength of it must necessarily be, in an exact proportion to the brightness and intensity of the luminous body. Since the introduction therefore of what is called the *Patent Lamp* (which must be allowed greatly to exceed all others in this important point) it is very natural to expect, that the utility of our present lights, which have hitherto had very happy effects, may be rendered much more complete, by applying a burner upon the same principle as the *Patent Lamp*, before the reflector, in lieu of that made use of at present. With this view, several experiments have already been tried, with a metal reflector of eighteen inches diameter; and those have suggested other experiments, which hold out still more extensive improvements. We tried the effect of small lenses with small reflectors, which proved the advantage of the principle, but could not get large lenses of solid glass made here, but got some blown in the form of a plano convex, like a bottle, and filled with strong brine to prevent their being broke by frost, which answered the purpose to magnify the light, but the heat of the blaze of the lamp and reflector broke them.

THESE

On Improved Glass Reflectors and Lamps, with Solid Glass
Lenses before them for Light-Houses.

THESE improvements were brought to *Liverpool* by Mr. Thomas Rogers, whose address was "Patentee for stained reflectors, &c." in *London*, related the history of his proceedings to the author as follows.

THE Trinity house in *London*, very generously built a temporary light-house on *Black Heath*, to try experiments to improve light-houses, and after they had done very laudably, advertised liberty to any other people to try experiments for this important purpose.

Mr. Rogers being in the glass trade as abovementioned, got reflectors blown in one piece of glass to their form, and by a new method silvered over the convex side without quick-silver, made them very bright good reflectors, and had what I call a large circular patent lamp three inches diameter, consequently the wick nine inches round, stands at the focus of the reflector, and before it a plain convex lens of solid glass twenty one inches diameter and five inches and a half thick in the focus, which makes the light answer the principle of the Magic lantern upon an enlarged scale.

THE first of this improvement was ordered and put in use at one of the Portland light-houses, next at the Hill of Hoath near *Dublin*, the report of them seems incredible, and to very great advantage in hazy and foggy weather. And he is now putting them up at *Waterford* light-house, and brought one of them here to *Liverpool*, and had it tried in three different places to compare with reflectors made with plain pieces of looking glass which it surpassed.

In the last conversation I had with him, his reflectors were but twelve inches diameter, he said he would get them enlarged to eighteen inches, then he reckoned he would not lose one ray of light from going through his lenses, which I hope will have a fair trial at our light-houses here, where we require the most perfect lights that can possibly be got made, not only to be seen at the greatest possible distance without our most extensive sand banks, to let ships see that they are in a fair way, but to diverge to each side as much as necessary, to let them see when they are out of a fair way, which is the most important, for ships in a fair way, are in no danger in comparison with those that are out of a fair way, as may be seen by the charts of our Harbour.

CIRCUMSTANCES

CIRCUMSTANCES of times and places are so variable, that no direct rule can be laid down for this purpose; yet something should be said to endeavour to prevent, as much as possible, running imprudent risks at improper times; which has to my knowledge occasioned great damage, and many total and fatal losses. --- When both time and tide prove favourable to a ship's situation, it is then a point of duty, and highly commendable, to push forward with all possible expedition to get into port.

But when either the time, or the tide proves unfavourable to a ship's situation, then it is the duty of the commander to be upon his guard, and to act with prudent caution, as the occasion may require; and to consider and consult what ought to be done; and not to be persuaded even by a pilot to run at an improper time of tide, or in the night, or when it rains, snows, hails, or in hazy or foggy weather, when it is well known that neither lights nor any other objects can be seen at a sufficient distance to keep clear of dangers; and where the lead, nor compass course, cannot be depended upon for guides. At such times and under such circumstances, and especially when the waves run dangerously high upon the shoals, the utmost endeavours should be used to keep clear of them till a favourable time and tide offer, to get into safety; and nothing but to save a ship from sinking, or foundering, in deep water, should be a sufficient reason for running farther among dangers than there is a prospect of safety, whilst there is any possibility to keep off from them.

ON RUNNING FOR LIVERPOOL AT IMPROPER TIMES.

TH E want of such prudent precautions and endeavours, as last mentioned, has occasioned great damage, and many fatal losses, in attempting at improper times to get into the port of Liverpool; where the dangers are so many and great, as to require not only a proper time of tide, but clear weather and day-light, to proceed with a common chance for safety.. Yet such has been the imprudence and folly of Pilots and commanders of ships, as to run for our dangerous crooked bar channels, when no guides could be seen, and no compass course nor the lead could be relied on; by which they have lost their ships and lives. And some fatal losses have been occasioned by subverting the very advan-

tageously designed use of our light-houses, which are to shew ships the way into *Hoylake*—a good road-stead---to wait for a suitable time and tide to get through the dangerous channels into the river, or to get and keep a ship in a fair way, to be ready to proceed through the dangerous parts of the channels, as the circumstances of the wind, time, and the tide flowing but a little after day-light, may require.

But the great abuse and ill use made of these lights, have been, in running in by the two sea lights, with gales of wind right upon the shore in the night ; and, instead of running into *Hoylake* by the two *Hoylake* lights, as abovementioned, they have attempted to run through our dangerous Rock channel, where the vessel has been beat all to pieces, and nothing but the floating wreck has made known the misfortune,---no people being saved to tell the melancholy tale---which might have been avoided by running into *Hoylake*, or keeping off, under sail, to windward of the sand banks, till the next day's tide ; as a Pilot of one of these unfortunate vessels was advised to do (when they boarded him) and which should be the practice of all ships trading to the port of *Liverpool*, whilst it is possible to be done. It is certainly better in a gale of wind to keep a ship under sail to windward, though it may be troublesome, than to risk riding upon a lee shore to wait for a proper time and tide ; and especially at the S. E. buoy of *Hoyle*, where the ships lie openly exposed to such high waves from the sea, as often to break the cables that have been long foreign voyages ; but if they hold, it prevents their heaving a head against the flood ; and to save tide, it is very common to cut or slip their cables, and run a risk in casting and getting the ship fairly under way at such times in so little room, without anchors to bring them up, as the occasion afterwards may require ; which has often been the cause of great damage, and always a certain expence and risk in getting the anchors again.

Recommended
not to run
till a pro-
per tide
offer.

To ob-
serve the
height of
the tide
by the
marks on
shore.

Danger of
running
too soon
tide.

ALL possible pains should likewise be taken by observing very nicely the marks on shore, (as mentioned in the instructions of the chart) to hit the proper time of tide according to the ships draught of water ; for when the waves run high, there may be as much danger in running too early, as too late, of the tide : for when the tide falls fast, a ship soon ceases from striking hard ; but which she continues to do all the time it flows, and may be drove out of the best of the channel ; for if a ship strikes till she loses her head way through the water, she is then left in a manner entirely to

to the power of the tide, wind, and waves, which may prove of fatal consequence at such times, by driving her quite out of the channel as the water flows, as we have sandbanks detached from the main, which have very little water upon them at common tides; so that a ship stands but little chance of beating over them, or the people of getting to the main, to save their lives, if they are obliged to quit her.

In the finest weather and smooth water, it requires great care to observe and manage so as to fall in with the shoal parts of these channels at the proper time of tide, and to have a breeze of wind to command the ship and keep her in a fair way and from being carried by the cross tides, that run over the sands, through the swatches, and false deeps, out of the proper channels, in spite of a boat towing a head, without a breeze. It is therefore too dangerous to attempt passing the channels in a calm. But where a calm or baffling winds are likely to happen when passing them, boats to tow, or the anchor ready to let go, should be made as ready as possible, to prevent the ship being carried on shore by these cross tides; which has often happened, and loss and great damage been the consequence, by the tide washing the sand from under her more in one place than another, that occasions her straining and does much more damage than if the ship laid on firm ground.

WHAT I think farther deserves particular notice on these occasions, is this; I have seen many instances of ships, by running too early in the tide, having come a ground upon a sand bank, with the flood tide running very strong over it; when, they have let go the anchor to prevent the ship driving farther on; and, though they have veered out a long scope of cable, have been much deceived in their expectation to bring the ship round with her head upon the tide to ride her; because, she drawing most water aft, it hangs her by the stern on the ground, nearly end on to the tide; so that the anchor seldom holds to bring her more than broadside to the tide; which increases the strain, to bring the anchor home; so that the swings and lies with her stern, nearly end on to the tide, as at first; and drives farther and farther on with the flood as the anchor comes home, which may prove of bad consequence in many situations. Therefore I have often thought that this might be prevented, by putting a spring or two upon the cable, with a rolling hitch, &c. to have two parts, one on each quarter, so as to ride the ship by the stern, till the tide

A hint to
ride a ship
by the
stern.

flows sufficient to give room to swing clear of the ground ; and, as the situation may require to sheer or cast her stern towards the deepest water, by slacking or letting the spring go on the side designed to cast her, to lay the strain on the spring, and the helm on the other quarter, taking care that the cable is clear of the heel ; by which means a ship may be swung, or ride by the stern, clear of the ground, till there is water to swing her, or till the tide is done, as the occasion may require.

On fogs. I HAVE known ships get a ground, and receive great damage, by being caught in the narrow and shoal parts of channels in a fog ; and as fogs are only low clouds, or moist dense vapours near the surface of the earth, I have heard of instances, where, by going to the mast head, they have got sight of objects for their guide, when nothing was to be seen from the decks ; and I recommend this expedient, as worth a trial, when there is occasion for it.

HAVING said so much on the *Construction and Management of Vessels*, in general ; I think it may be of some use if I add a few observations on the conducting of them in time of *War*, so as best to provide for their security, and the annoyance of the *Enemy*.

ON LETTER OF MARQUE SHIPS AND PRIVATEERS.

THIS is a business that has, and, most likely, always will be pursued in this kingdom, in time of war with other trading nations. Ships, as well as armies, are well known to be more or less powerful, according to their force, in proportion as the people are disciplined and exercised in their duty. I have known our people vastly at a loss, both in privateers and merchants ships when a war has happened after a long peace. In the first part of the war of 1739, I was in an *East India* ship of 32 guns ; and a letter of marque ship in the *Jamaica* trade ; where our great guns and small arms were never exercised, because none on board either ship, knew how it was to be done ; which might have been the occasion of the loss of ourselves and ships, if we had happened to have fallen in and engaged with disciplined ships of equal force, which, it must be allowed, have greatly the advantage over ships whose crews are not disciplined ; for even the more daring and brave they are, the sooner they are liable to fall into confusion ; and

and which our people are most liable to, from being in general too eager to fight, and regardless of dangers from superior discipline or force, or any other disadvantages that may attend their situation. This proves the necessity that some instructions should be attempted for our letter of marque ships and privateers, to prevent, as much as possible, their suffering from their own extraordinary courage and bravery alone. Therefore, from the experience of two wars, I shall endeavour to point out what I think may be of some service in the beginning of a war, to fit them the better to attack an enemy; or, being attacked, to defend themselves in the course of a voyage, or on a cruise against the enemy.

BUT I must own this is a task much more fit for those gentlemen who have had the experience of the late brave actions and improved discipline of our incomparable Royal Navy. And as I never had that advantage, I hope my defects will be thought the more excusable.

On Fitting out Letter of Marque Ships and Privateers.

SA F E T Y, as well as success, in my opinion, depends greatly on the manner these ships are fitted out. Trading ships designed more for defence than offence, I would recommend to be made to look as big, powerful, and warlike as possible, in order to intimidate; but privateers the contrary, to look as little and defenceless, and conceal their power, as much as possible, till there is a real occasion for it; and then as suddenly as possible to make it known, to give the greater surprise; which I can say from experience may often give great advantages.

As to the size and number of great guns; the dimensions, strength, and properties of the ship, (as mentioned from page 30 to 37) should point out what she will be able to bear without being too crank for a sailing and a fighting ship; and though it must be allowed that the advantages in a sea fight are greatly in favour of the heaviest shot; yet the many storms a ship may have to contend with, in a winter's passage, or a cruise in a turbulent ocean where the great guns may be often rendered an useless and dangerous incumbrance, by the waves running so high, that nothing but small arms can be used against the enemy, so a ship should

should not be over-crowded, or over-burdened with too heavy cannon.

ON IMPROVING GREAT GUNS AND CARRIAGES.

IN order to remedy those great disadvantages which I have experienced in the difficulty and great delay of getting our common guns mounted on common carriages, and pointed to my mind on the objects aimed at, not only in merchant's ships, but on batteries on shore with the King's guns and carriages at *Liverpool*, where I had the command, (as represented plate 11. fig. 6.) I recommended to have our great guns cast with an oval knob on the top of the muzzle, with a score filed on it, and another on the breech, exactly parallel with the bore of the gun, so as to make one direct sight to the object aimed at (as represented fig. 7, plate 11.) and mounted on, what I call, a swivel carriage; which is not only a great advantage to a ship in carrying her great guns with more ease and safety than the common carriage, but to the men in exercising and fighting them; which I shall endeavour to prove from reason and experience.

Short and light guns cast with an oval knob on their muzzles recommended.

OUR late improvement, in the metal, casting, and boring of iron cannon, makes me recommend that they may be made short, and as light of metal as possible to bear a sufficient proof; which not only gives proportional safety and ease to a ship, in the times abovementioned, but they are managed and fought with greater safety, ease, and expedition, and will do sufficient execution at the short distance the bravery of our people makes it necessary to fight our ships to the greatest advantage.

ON THE COMMON GUN CARRIAGE.

GREAT guns, mounted on these carriages to be ready at sea in time of war, are commonly carried either run out of the ports, or kept housed, with their muzzles against the ship's side at the upper parts of the ports, as represented by one in letter D, plate 9, but which is delineated in a much more masterly manner in

in *Falconer's Marine Dictionary* (which came out a good while after my plates where struck off.) In this 7th plate, the guns are represented, both run out, and stowed as last mentioned, fig. 19, with the muzzle against the side of the ship above the port; and he very judiciously remarks, in the securing the guns, to hook the tackles so that a second breeching may be added, lashed and bowdied as tight as possible, to prevent the guns from breaking loose, which may be productive of dangerous consequences: and this by report has so often happened in our Royal Navy, that it was conjectured, that the Victory, a first rate ship of war, was lost by it. Therefore this method of carrying great guns deserves more particular notice.

ON THE METHOD OF CARRYING LOWER DECK GUNS.

I MEAN on this occasion to speak principally from the experience of only one ship, that had only been three voyages to the *East Indies*, when she was fitted out first to cruise three months off the *Western Islands*. We carried thirty-two guns, and eight of them twelve pounders on the lower deck, housed as last mentioned, with their muzzles against the ship's side above the ports, which, when the waves run high, did so work the ship, to such dangerous degrees, that for the safety of the whole, we were obliged at different times to put these guns down into the hold, and to leave our station and run for safety to a port, to get our leaks stopped.

NOTWITHSTANDING this method is general, in all large ships of war that carry lower deck guns; yet I appeal to reason, and all who have observed or considered, what occasions these guns to make so much noise, and fetch so much way in and out; for as the ship rolls, works, and labours at sea, as has been mentioned, so must these guns be an additional power according to their weight and number added to the weight above them, of masts, yards, rigging and sails, all which combine with high waves to strain and make the ship's sides bend, and fetch the more way, as she rolls, and especially in that part made weak by the tier of lower deck ports, a little above the water's edge, where these guns are secured in the manner abovementioned by their breechings at the lower part of the ports, and their muzzles to the side above the ports, which part must naturally bend and give more way when the

The cause
of lower
deck guns
breaking
loose.

the ship rolls, than the lower part of the ports, where the breechings are made fast (as may be seen by the figures abovementioned): by which it must appear evident to reason, that of this tier of guns, in every violent low roll the ship makes, those on the lower lee side (as it may be called) must move altogether, and press their muzzles with great power against this lee side so as to strain it outwards, and to slack the tackles and breechings greatly, when at the same time the weather, or upper side, bends in proportion against the muzzles of the weather guns, to force them inwards farther than the stretching and straining of the breechings can, with safety, be expected to allow; so that I rather wonder that they do not break loose oftener, especially in old, weak, laboursome ships, and that, more frequently in three deck ships than in two deckers, because they have so much more weight and two tier of guns above them, to strain and work the ship the more, in proportion, at the lower deck ports, as abovementioned.

ON CARRYING THE GUNS RUN OUT.

BY this method it must be allowed, that they are carried with more ease and safety from the damage and danger abovementioned, secured only with their two tackles, that confines the breast of the carriage close to the side at the fill of the port, where the straining of the ship can have little effect between that and the deck, so as to make the guns fetch any way worth notice. But their projecting so far without board, exposes them at all times, and to all weathers; and each gun must have, what is called, a half port; which are both troublesome and combersome; and the gun ports must be kept hauled up, which makes what may be called a rough and incumbered outside, and which in small and deep loaded ships, when carrying a stiff sail upon a wind, are plunged into the sea, and stops water to leeward, whilst those to windward hold wind; which must naturally be a great hinderance to a ship sailing upon a wind, and be liable to wet the charge in the guns. Therefore to remedy these defects, and other inconveniences that attend the great guns being mounted on the common carriage, is the reason why I take the liberty to speak in commendation of a fair trial to be made of swivel carriages for great guns.

THIS

THIS carriage must be allowed to be some what more complex than the common one, because it consists of two parts: the carriage part, with the iron work for the gun, takles, and breechings, as in common with other carriages; and the sole of the carriage, on which it swivels or turns, as occasion requires, as represented by the figures E and F, plate 9. We had a set of them made for the *Liverpool* Privateer's guns, that carried twelve pound shot. The sole parts, as represented by the figure F, were made about three inches thick, with iron axes, and lignum vita six inch trucks; so that the gun should be just swivelled about over them on the short bolt, figure 5, that was drove upwards with a square head below, that had holes in the corners for four nails, and a square plate above, a little rounding upwards, with holes at the corners, fitting the bolt, and let in, even with the sole; at the inner part of which is fixed a dove-tail plate, with an eye for the train takle, and two iron palls that turn in grooves, in and out, with the direction of the sole on the ends of the eye bolts, exactly to confine the gun and carriage in a straight direction with the sole, as shewn by the figure 6, in the train part of the sole.

THE carriage part E, was made, as in common without the carriages, to fit the size of the gun, and, when upon the sole, the height of the port; and, to unite it to the sole part, a three inch plank was fixed right under the trunnions of the gun, with the four bolts of the trunnion irons clinched through it, even with the wood, and likewise fastened to the cross breast-piece of the carriage, with a hole and two square plates, one above and another below in the middle, as represented figure 4, at E, just to fit and turn easily round the centre bolt in the sole figure 5, where a double forelock goes through the upper end to secure together the sole and carriage part. At the inner or train part, is fixed an inch plank, fastened with the eye-bolts, for the gun takles, clinched through it, for the bed and quoin of the gun to rest upon; and all this lower part of the carriage, as well as the upper part of the sole, was made as plain and smooth as possible; and the stress or friction lay chiefly on the two iron plates under the body of the piece; so that when the two palls were turned back, the guns could be easily swivelled round by hand, any way the occasion required.

THE circumstance of these swivel carriages carrying the guns with more convenience, ease, and safety to the ship than the common carriage, must be allowed to deserve some notice and attention; for on a winter's cruise or passage in a turbulent ocean, there

may be more danger from the violence of the waves to be contended with, than from the enemies ships; and the guns mounted on these carriages, after exercise or action, at the word of command to house and secure the guns, are swivelled round upon the soles fore and aft, with their muzzles forward; then the takles are hooked to the two eye-bolts at the train of the sole, which is bowed with the gun close to the side, and there secured by hooking the takles to the eye and ring-bolts, of the carriage part, and to those in the side where the takele-falls are expended in lashings round and about the guns; by which they may be secured and stowed snug, and the most out of the way that is possible, either on the upper or lower deck, close to the ship's side, without pressing hard against it; all their weight, within board, resting on the ends of the beams and the lodging and hanging knees, where the decks and the ship's sides are strongest to support and carry them, not only with more ease and safety, but it affords more room within board to work and manage the ship, than when they are carried run out, and gives the advantage of keeping all the ports close shut to keep the guns dry in small or deep loaded ships, and conceals them till it is necessary to shew them, and avoids all the other disadvantages that have been mentioned to attend their being carried constantly run out. These reasons, and other advantages that I have experienced to attend the swivel carriages, I hope will be thought sufficient to recommend them for the purpose of carrying the guns with more ease and safety to the ship, than the common carriage, either on the upper or lower deck; where the difference is represented by the two guns in figure D, plate 9. And in order to bring into practice what I call the improved gun and carriage, I got a small cannon cast with an oval knob on the top of the muzzle, as mentioned page 191, with a small hole in the cascabel, and a small iron crow, fitted to it, and mounted on a swivel carriage, as represented figure 7, plate 11.

On the Disadvantages of the Common Guns and Carriages.

A COMPARATIVE difference can only be known by fair trials in practice, either in exercise or action, when orders cannot be heard, and must be given by signs made by hand to get the common carriage and gun pointed to the object aimed at, as represented

represented fig. 6, plate 11; where the captain of the gun is first obliged to stoop low, to look along the side sights, and then to make motions with his hands to his help mates, who with their hand-spikes, raise or fall the metal to the level of the object. He then looks along the top sights, and taps with his hand on the side of the carriage for the men to breech the gun fore and aft, till he can get it in a straight direction to the object; which is often long and tedious; for the men are liable to breech the gun two far, or not far enough, which tires his patience, especially when he hears other guns fired long before his, and makes him make the signal to fire, though wide of the enemy, rather than be thought so much behind the others, who may, to shew themselves brisk, be induced to fire at random, if not strictly attended to by their officers, who cannot attend every gun; by which our ammunition is expended to no purpose. And when the situation of the enemy requires the gun to be pointed as much forward or aft as the port will allow; (as represented figure C, plate 9) it may be perceived how the common gun and carriage will recoil a great way from the port, and especially if the lee guns and the ship's heel occasion time and trouble to get it opposite to the port again, where the men are exposed to the enemies small shot all the time of charging the gun again, as may be perceived by the common gun and carriage as represented fig. D, plate 9. And neither the side nor top sights of these guns point direct to the object aimed at; for from the muzzle being so much smaller than the breech, the side sights point wide of the object, and the top ones below it, even at a point blank distance; which increases the perplexity and the difficulty to hit it.

On the Advantages of the Improved Gun and Carriage, above the Common ones.

TO make a fair comparison of the great advantages of these guns and carriages above the common ones, as last mentioned.—In the *Liverpool Privateer*, our spare carriages were of the common sort; and at a favourable opportunity, when going to exercise our great guns, I ordered, and had one of them mounted on a common carriage nearly a-midships; and to make a fair trial of the difference, had it exercised with the same number of men

Improved GUN and CARRIAGE, above the Common ones.

as we used to do with the other guns, and gave the word of command proportionally slower than usual, and as this gun required, till the people had got expert in working it; then had an empty caulk put out for this and the swivel gun to be pointed at, and ordered them to go through all the motions of charging and firing as fast as they could, pointed at the caulk; and the difference of time, observed by my officers and myself, between the gun on the swivel carriage, and that on the common carriage, in discharging, was five times of the swivel gun for three of that of the common carriage; and the men at the common carriage were so greatly tired with their hard labour, in proportion to those at the swivel carriage next them, that they begged to have their gun mounted on the swivel carriage, which was done.

In action they have likewise greatly the advantage, not only of being fired so much oftener, but with more ease and certainty to do execution; for when the gun is run out, the captain of the gun himself can put the crow in the caseable, and put his shoulder under it; and by looking along the top sight, that is parallel to the bore, and by twisting his body, can swivel the carriage and point the gun direct to the object; and, with his hands at liberty, can fix the bed and quoin to keep it there (as represented figure 7, plate 11.) then holding up his right hand for his help mates to give the match or fire iron, he gets up and pulls out the crow with his left hand, and fires the gun himself at the most favourable instant to do execution; as may be perceived by comparing it to figure 6, and what has been said on this occasion. And when the situation of the enemy requires the guns to be pointed as much forward or aft as the ports will allow (as represented plate 9, figure C) it may be perceived that the sole of the swivel carriage stands in a direction right in and out; so that when the guns are fired, they recoil right back opposite to the part, and the gun is swivelled with its muzzle forward, where it may be charged again by the people, sheltered from any small shot that may be fired in at the port, and which the common carriages are exposed to, as represented figure D, plate 9.

BUT it must be acknowledged, that these swivel carriages require a little extraordinary trouble to keep the upper part of the soles clean, and greased a little at times, to make the guns swivel easily upon them. As it is common to hear objections against new things, the only one I have heard against these, is, that they would not stand a long and contested fight; which I own we had not

not the trial of, having learned from experience, that to make the contest short in our favour, was to get so near the enemy that our people could not well miss their object. But as the tackles and breechings are all upon the carriage part, I could not perceive, from all my experience, that they would not bear as long firing as the common carriage; for the centre bolt, &c. has nothing to move but the weight of the sole. After this I was induced to think this carriage worthy the notice of the managers of our Royal Navy, therefore I got a nice model with a gilt gun, &c. made, and a friend to present it to Lord *Anson*, then at the head of the Admiralty; and I was ready to give a report of it: but my well meant endeavours were disregarded, for I never heard or saw anything of my gun or carriage afterwards.

ON FORTIFYING THE QUARTER-DECK.

WHATEVER may contribute to shelter and save the people, must be allowed to deserve notice. Various methods and things have been tried for this purpose. I was in a ship that had bags of ox hair, that was said would resist even cannon shot: but in fighting with a French frigate, I saw one of her shot go through eighteen inch of hair, through the middle of an eighteen inch mast, and a long way over our ship afterwards; which proves no fence can be made about a ship against cannon shot; but against small and musket shot, a fence may be made many ways.

HOWEVER this fence or breast work may be made to shelter the people from small shot, in common they are no more than breast high, so that the musketeers can fire fairly over them upon the enemy. But from experience in fighting, I have observed among new fighting men, there will always be something to shew that natural instinct of self preservation; and in order to keep their heads under shelter of the breast work from the enemies shot, they fire their muskets at random up into the air. Seeing this, and to prevent the bad effect of such examples in fighting, I have made a feigned lunge at a man's breast with my drawn sword, and have been obliged to threaten death to any man that should show such a bad example; though it must be allowed to be only a failing, and not a fault among new undisciplined landsmen, first coming to action, who at seeing a man shot through the head

above

ON CARRYING SWIVEL GUNS IN THE TOPS.

above the breast work, may show a little fear, but by practice may prove brave afterwards.

THEREFORE to remedy this defect which I perceived in fighting the small arms ; in fitting out a privateer afterwards, we had a rail, as in common, breast high on each side the quarter deck ; and on the rails were fixed light iron crutches, with the arms about a foot square, and a shoulder to keep the bottom of the crutches about six inches above the rails, and thin boards about six inches broad, laid upon the bottom of the crutches ; and netting, with large square meshes, were formed just to hold a hammock with its bedding longways ; and from the gunnel to the rail was boarded up on each side of the stanchions, and filled up with rope shakings, cork shavings, &c. which are found sufficient proof against musket ball ; which made so ready and good a fence for the quarter deck musketeers, that the most timorous could point his piece with the utmost confidence between the rail and the netting, and fire right upon the enemy, by having his head, as well as his body, under such secure shelter.

For the same reasons in clearing and preparing the ship for fighting, I used to make the forecastle and top men, lash the hammocks, to shelter them, horizontally on the outside of the fore and top-mast shrouds, close to one another, breast-high, and then a single hammock above, leaving a little vacancy to point and fire their muskets through ; which guards that tender and most important seat of knowledge, the head, as well as the other parts of the body which it governs, from the enemies small shot.

ON CARRYING SWIVEL GUNS IN THE TOPS.

TH E high situation of these guns promises a great advantage to do great execution in cloe fighting ; but I have learned from experience, that there is not room in a small ship's top to fight these guns without great danger of fire, and blowing up the ammunition chest, which we had once the misfortune to do, and which killed one of our top-men : For which reasons, and the great weight and incumbrance of them and their ammunition at so great a height, makes me recommend muskets only to be carried in the tops of small ships, as they can be pointed and fired in all directions as occasion may require, and are so easily and readily charged,

charged, that they are to be prefered to all combined pieces, called organs, &c. which are also under the disadvantage of taking up more time in proportion to the musket, in charging them after firing.

ON THE POWDER AND SHOT.

AS the execution of the shot to conquer an enemy depends entirely on the goodness and strength of the powder, which differs so much, that the greatest care and caution is absolutely necessary to guard against being cheated in the quality of the powder. I have experienced some that looked very fine and good, made for the use, or rather shameful abuse, of the *African* trade, that instead of firing shot with sufficient velocity, it would hardly fire itself, but spend itself in phizzing one phiz after another out at the touch hole, and took up so much time in burning, that it could not be used as priming for great guns.

This base practice of making so very weak powder, should by some means be put a stop to; because it not only hurts the merchant adventurer, but the intention of government in giving so large a bounty on exportation for the encouragement of the trade of making good gun-powder. Therefore it should be either under the inspection of proper assay masters, or examined by proper methods to try its strength; for I can say from experience, that, the common small pistol powder provers, that drive a circular graduated plate round, do not answer the purpose, for they will differ greatly with the same powder.

THE THEREFORE I would recommend for this purpose of trying powder, to have a gun of a half pound shot, fixed in a convenient place, mounted firm on a good block or bed, elevated exactly at fortyfive degrees; and the powder to be tried, by an ounce charge, how far it will throw the half pound shot without any wad; and so in proportion for every foot or yard's distance under or over a standard distance, that might be fixed by government powder, to ascertain its strength and value under or over proof, according to the different trade or purpose it is designed for, as well as for privateers or letter of marque ships, which should be of equal goodness with that for the Royal Navy. Then, I reckon a quarter of the weight of the shot, would be sufficient charge of powder for great

To prove
the pow-
der.

great guns ; and which we had confirmed by fair trials of many actual experiments for the purpose, with a twelve pounder and a three pound charge of powder ; for when we added to it, it encreased the recoil of the gun and the resistance of the air to the shot in proportion, so that it made but little difference in the extent of the range.

Of shot ; the first and principal, both for quantity and quality, is the round iron cannon ball, because it will go and penetrate farther, and with a greater velocity, than any other, to do execution, when engaging with a superior force ; but when come to a close fight with a ship of inferior force, expecting to make her a prize, then the endeavours should be not to destroy the ship, if it can possibly be avoided, but to distress them to make submission ; therefore some suitable shot, that will answer that purpose best, should be provided. And I would recommend round tin cases (to fit the bore of the guns) filled with musket ball ; and square bar iron, cut about fourteen inches long, tied in bundles with rope-yarns just to fit the guns ; or cast iron bars about the same length, a square one about an inch diameter in the middle, and four others quartering, rounded on the outside to fit the bore of the guns, when tied with rope-yarns.

On canon and
musket
balls, &c.

ON PRIMING GREAT GUNS WITH GUN POWDER.

THIS method is not only very long and tedious in practice, but very uncertain to get the guns fired in good time, so as to hit the object aimed at ; and is very dangerous from the scattered powder on the decks, which makes a train and takes fire from the sparks of the gun match falling on the decks, that has often been, and always is liable to occasion those dreadful explosions that destroy both men and ships, by which I have had my crew greatly hurt. And other great disadvantages attend it ; for if the guns are not fired directly after being primed, it soon grows hard in the touch-hole, and renders the gun useless till it can be cleared. These important reasons induced me to endeavour to bring into practice the method of priming our great guns with Quick Match.

THIS

THIS *Quick-Match* is made of white worsted yarn, in length three or four feet, and two or three threads thick, so as it may be easily thrust double through the touch-holes, about an inch into the cartridge, by flat pricklers, made forked at the lower end for that purpose. These lengths of worsted are soaked in a mixture of fresh water and gun-powder, of the consistence of treacle; then they are rolled in dry mealed gun-powder, that is bruised fine by the side of a glass bottle upon a smooth board, and drawn through the left hand till there is a coat of gun-powder paste round them; which completes the *Quick-Match*. When thoroughly dried and cut in exact lengths, twice the length of the wire pricklers, and stowed in copper or tin cases with their brights up, they may readily be put upon the forked ends of the pricklers; then with the ends between the fingers, when the cartridge is felt to be home, thrust the brights directly about an inch into the cartridge, draw the pricklers, and leave the two ends above the touch-hole, either to fire, or draw out again as occasion may require.

IT was made in *Liverpool* last war for sale, by Mr. *Henry Ross*, an ingenious experienced old commander of ships, calling it "LIVERPOOL PRIMING;" he has wrote upon its great advantages, not only for safety to avoid the great damage and loss of men and ships, lately occasioned by priming and firing with powder and gun match as abovementioned, but the great difference it makes in quick firing the guns to hit the object; on which alone depends success in action when ships are constantly altering their positions, with the great difference of time that may be observed between the flash of priming and the discharge of the gun, so that I have known a gun pointed to hit one ship, and the shot has hit another, a friend's ship lying wide of her.

We have made public trials with this *Qyick-Match*, and fired a twelve pounder with it above four times for one primed with powder: Thus a ship's force may be above trebled by firing above four guns for one, and to a much greater certainty of hitting the enemy. It was fired with the common gun match, with the flame of a lamp I got made for the purpose of trial, and with the lock of a small pocket pistol.

IT is well known from experience, that gun match is not only very dangerous from sparks falling on the decks, when blowing it, and striking it on the priming as abovementioned, but very defective, after all, to get the guns fitted in good time, for a chance to hit the designed object in action. Therefore I would recommend hot irons, which, it is well known, from experience will fire great guns, primed either with powder or quick-match, much safer, and surer to hit their mark, than with the gun match; and which induced me to get firing irons, an inch and a half thick at the heating ends; with sockets about the same thickness for wood handles; which made their whole length about twenty inches; and a small fire stove made of thin iron plate, round like a large can, ten inches deep, and ten broad at the bottom, cut full of half inch round holes, and eight of them round the side, an inch above the bottom, four inches open at the top with a lid to it, and four holes in the sides for the irons; and a wood handle that goes into a socket at the side, and stands upon three spreading feet six inches long, as represented figure 8, plate 11, that it may stand in match tubs with three inches water in them as in common, that will preserve them from all accidental harm; so that the guns that are too far from the cook's fire place, may have their firing irons heated readily, and kept hot with safety in these stoves, which I have tried, and have heated the irons both with pit coal and charcoal in about eight minutes time; and with about four pounds of charcoal, which is clearest of smoke, I kept four irons hot for about three hours.

THE wood handles require a piece of leather within the sockets, to prevent the wood burning.

TH E readiest and best method to do this, is first to station them according to their rank and capacities, by what is called a Quarter Bill; and to exercise them in their respective stations, as now recommended.

BUT merchant ships are so variously fitted out with guns and men, that it is impossible to form a Quarter Bill to suit all; therefore I shall endeavour to form two Quarter Bills, one for a trading ship of fourteen six pounders and fifty men; and the other for a privateer of twenty nine pounders and 160 men, with common carriages; which may be varied, as circumstances and the difference of guns, carriages, and men may require.

A Quarter Bill for a Trading Ship of Fourteen Six Pounders, and Fifty Men.

The Captain to command in chief, on the quarter deck, if it be fortified to afford common shelter from small-arms.	1
The Chief Mate to command the six foremost guns, and work the ship, forward.	1
The Second Mate to command the eight aftermost guns.	1
The Boatswain to pass the word and get the Captain's orders executed fore and aft, as occasion may require.	1
The Carpenter to attend the pumps, shot plugs, &c.	1
The Gunner to deliver the powder to the boys, as carriers.	1
The Doctor in the lowest, safest and most convenient place the ship affords.	1
A good Helmsman.	1
Four men to each gun and its opposite, and a boy to fetch powder.	35
Seven men at small-arms and occasional duty.	7
	<hr/> 50

A Quarter Bill for a Privateer of Twenty Guns, Nine Pounders; and Four Thrice Pounders on the Quarter-Deck and Forecastle.

On the QUARTER DECK.

The Captain to command the whole.	1
The Master to assist, and work the ship according to orders.	1
A Midshipman to pass the word of command fore and aft.	1
E c 2	A Quarter

ON THE MAIN DECK.

A Quarter Master at the gun, and another at the helm.	2
The first Marine Officer with twenty four musketeers.	25.
Three men for the two 3 pounders, and a boy to fetch powder.	4

ON THE MAIN DECK.

The First Lieutenant to command the ten foremost guns.	1
The Second Lieutenant to command the ten aftermost guns.	1
The Gunner to assist and attend all the great guns fore and aft.	1
The two Master's mates to attend the fore-top-sail-braces, and work the ship, forward, according to orders.	2
The Boatswain's-mate, with two seamen, to assist in working the ship, and to repair the main rigging.	3
The Carpenter and his crew to attend the pumps, and the wings about the water's edge, fore and aft, with shot plugs, &c.	4
Six men to each of the ten guns on a side, and its opposite, and a boy to fetch powder.	70.

ON THE FORECASTLE.

The Boatswain to command, with two seamen to work the ship and repair the fore rigging.	3
Three men and a boy, to fetch powder for the two three pounders.	4
The Second Marine-officer with nine musketeers.	10
In the barge upon the booms, the third Marine-officer, with eight Musketeers.	9
In the main-top, five men with a Midshipman at small-arms, and to observe the conduct and condition of the enemy.	6
In the fore-top, 5 men at small-arms, and to repair the rigging.	5
In the mizen-top, 3 men at small-arms, and to repair the rigging.	3
In the powder room, the Gunner's mate with an assistant, to fill and hand powder to the boys, carriers.	2
In the cock-pit, the Doctor and his mate.	2
	<hr/> 160 <hr/>

HERE

HERE it may not be amiss to remark, that the people should be quartered to fight nearest to where they are stationed to work the ship ; that is, the after guard on the quarter deck ; the waisters in the waist ; forecastle men, that are necessary, on the forecastle, &c. The quarter bill and discipline of the crew should be kept from disorder, as long as possible ; and when occasional duty requires people to be let go from their quarters, it should not be done at random, but with judgment, such as will suit the occasion, from the musketeers, or a man from each great gun, &c. where they can be best spared to continue in, or be brought to action, in the most regular order that is possible..

ON PREPARING FOR EXERCISE OR ACTION.

WHEN all hands are called to quarters, every man should bring his hammock, well lashed up, and stow it to the greatest advantage, to give shelter from small arms, (as recommended page 214) nearest to his own quarters ; or to give them to some of his messmates where they are most wanted, that they may know readily where to find them when exercise or action is over.

WHEN the hammocks are properly stowed, the officers, according to their stations and duties, are to see the ship effectually cleared of all incumbrances, and every thing prepared, so that nothing may be wanting, that is necessary for exercise or action.

THE Lieutenants or mates, with the Gunner on the gun deck, are to get all the hatches laid, except *that* where the powder is to be handed up ; a match tub, half filled with water, and four matches in the notches, placed as near midship as possible, to serve two guns and their opposites ; also swabs to wet the decks, to prevent the fatal consequences that may attend the scattered and blown powder from the priming of the guns making a train fore and aft, which I have known take fire from the firing of the guns, and do great damage ; and which in my opinion has often been the cause of blowing ships up. And they should see that the captain of each gun has his men, powder horn, rope, sponge, rammer, crows, handspikes, and train takles, all ready in their proper places.

THE Boatswain must get the yards flung, the top-sail-sheets stoppered, and marlingspikes ready to repair the standing and running rigging that may be damaged.

THE

Exercise of Great Guns, Mounted on Common Carriages.

THE Carpenters are to get the pumps rigged, and shot plugs, with all that is necessary, ready in their proper places, to stop leaks and repair damages,

THE Gunner, when preparing for action, is to see that the charges in the guns are dry, and that there is a sufficient quantity of wads and shot of all sorts, and cartridges ready filled.

THE Marine-officers are to see all the musketeers at their quarters, with their arms and ammunition in good order, for exercise or action.

Exercise of Great Guns, Mounted on Common Carriages.

THE guns are supposed to be properly charged, and run out as customary, but not primed.

First. Silence, and give Attention to the Word of Command.

Second. Take out the Tompions, and cast loose your Guns.

THE tompions to be taken out and laid by, within board; the gun tackles cast off; the breechings rendered through the thimble at the breech, to the middle, so long as to let the gun recoil far enough to charge within board; the train tackles hooked ready to bowse the guns in, after the motion to fire is made.

Third. Prime your Guns.

THE cartridge is to be pricked through with the priming wire, and the vent and pan filled with powder, which is to be bruised on the flat part of the pan, with the round part of the horn, which ought to be hung up, out of danger from the flash of the priming; better a midships than to the side.

Fourth. Point your Guns.

As the voice cannot be heard in action, this should be done by signs and motions; and if the guns are sighted as they ought to be, with scores filed at the sides and top of the breech and muzzle, in the direction of the bore, the Captain of the gun is to look by the side sights first, and apply one hand to the bed or coin, and make motions with the other hand, upwards or downwards, for the men on each side looking at him, with handspikes to raise or fall the breech of the gun, till it points level to the object; then looking

looking along the top sights, tap with his hand more or less on the side of the gun, as it requires to be breeched fore or aft by the men with their crows or handspikes, till it points directly to the object; then he is to make the motion to fire, by flipping the gun, with both hands at a time, jumping briskly on one side abeam the gun.

THE man that is to fire the gun, should strike and blow the match over the match tub clear of ashes, and stand ready on the fore side of the gun out of the way of the trucks, so that he can strike the fired part of the match on the bruised part of the priming, but not over the vent, for that will blow the match out, but if fired with a hot iron, as recommended, the nearer the vent the better.

BEFORE the motion or word of command is giving to fire, the overseeing officers should frequently look how the guns are levelled, or point to the object, and encourage and instruct the people to do all their exercise cheerfully, expeditiously and perfectly, but especially to take all possible pains to prevent making the motion to fire before the guns are pointed to the best advantage, on the object aimed at, page 212, because on this, success in action entirely depends.

Fifth. Fire.

AFTER this motion is made, the guns are to be hauled in by their train tackles, so far as they may be easily charged with-in-board, with rope, sponges, and rammers.

Sixth. Sponge and Charge your Guns.

THE Captain of the gun is to stop the vent close with his thumb, whilst a man sponges it to the bottom of the bore, turning the sponge round, to extinguish any fire and dry up any moisture left by the powder, which he must strike off from the sponge, when drawn out, against the outside of the gun, and shift the rammer's end ready to charge, standing at the fore side of the gun. While this is doing, the boy with the cartridge of powder, (who for safety is to stand as far from the guns as he can till fired), is then to give the cartridge to a man at the after side of the gun, who must put it in with its bottom end first, and the seam downwards, as far as he can with his hand: it must then be rammed down, till the captain of the gun, with his priming wire in the vent, feels the cartridge, and calls out *home*, or makes a motion to

EXERCISE OF SMBLL ARMS.

to that purpose: then the rammer is to be drawn out, and the shot being according to orders, ready, must then be put into the gun with a wad, which are to be rammed to the charge, and struck with two forcible strokes; then the rammer is to be drawn and laid in its place, clear of the gun, and the captain of the gun is then to prick and prime as beforementioned.

Seventh. *Run out and point your Guns to the Object.*

THE Captain of the guns is to look if the object be before the beam; if it is, the guns are to be bowfed out to the after side of the ports; but if abaft the beam, to the fore side of the ports, that they may be readier pointed at the object, taking care that they do not touch the sides of the ports, when fired.

THUS the exercise should be repeated, with coolness and good-nature, till the people are expert at charging and firing; then they should be trained to fire by platoons, or what I think much better, only to fire every other gun; by which a continued fire is kept up, and no part left unguarded when in danger of being boarded and overcome by numbers, and to go from one side to the other, as occasion may require.

EXERCISE OF SMALL ARMS.

THE men are to be drawn up accoutred, with their muskets on their left shoulders, cartouch boxes right before them, and cutlasses in their belts on their left sides: The example of a cisciplined man to perform all the motions in the most perfect manner before them, is very necessary to make them soon perfect.

AFTER ordering silence, and to give attention to the word of command, and for the reasons given, I would recommend, at first, only the words of comand and motions, as represented plate 11th.

First. *Kneel on the right Knee and Prime.*

POISE your musket, just before the lock on the left hand, rested on the left knee; open your pan with the right thumb; handle your cartridge, and bite off the spare end; prime and shut your pan with the palm of the right hand, as represented plate 11th, figure 1.

Second.

Second. *Cast about your Musket, and charge with Cartridge.*

THE musket is to be lifted with the left hand, and turned on the left side, with the but end on the deck and the barrel down-wards, so that the cartridge may be put into the barrel with ease, and the powder shaked all out of it, pushing it down with the fore finger; draw the rammer, ram down the charge, and return the rammer, as represented, figure 2.

Third. *Recover your Arms, and make ready.*

BRING the musket with the left hand round the left knee, with the barrel towards you, place it upright with the but end on the deck, by the right knee, and place your right thumb on the cock, as represented figure 3.

Fourth. *Cock, Present and Fire.*

EITHER on the knee or standing, as represented figure 4 and 5 according to order, or as the shelter of the station may require.

Fifth. *Recover, and half cock, your Firelocks.*

PRIME and load on the knee as before; continuing to exercise at all opportunities, till the people are become expert in their motions.

THEN it will be necessary to exercise every man singly, by turns, to load and fire with ball at a circular chalk mark, made a foot from the lower end of a board about five feet long, fastened to one of the fore-top-mast-studding-sail-boom ends; so that when it is rigged out, the mark may face towards the quarter deck; and to give a small reward, as an encouragement, to the man who hits nearest the center of the mark.

ON KEEPING A CLEAN BOTTOM.

THE great difference this makes in a ship's steering, working, and sailing, makes it a matter of such importance, that all possible means should be used to prevent the ship's bottom from growing foul: and the best method that I have experienced for this purpose, is to be provided with what I call a caulk-scrubber, as represented plate 9, figure A, which I have often used in different ships with success, when at an anchor, and in calm weather

ON KEEPING A CLEAN BOTTOM.

weather on the open ocean. I had these scrubbers made of elm board about an inch thick and twelve broad, the middle part of the frame just to fit a ten gallon cask, that was lashed to the battions at each end, and the long square spaces on each side of the cask were filled with birch broom stuff, which projected about six inches without the frame, and wedged fast towards the ends with long wedges against boards that slide with small tenants at each end in a groove to keep the birch fast and firm, for scrubbing the bottom, even close down to the keel, and the iron work which unites the two parts by a joint that they may the more naturally play to the curved or rounding parts of the ship's bottom, with the slings and the ropes fastened to the eye-bolts; all which may be perceived and understood by looking with attention at the figure that represents that side of the scrubber that is hauled next to the ship's bottom.

In using this cask-scrubber I had a block lashed under the bowsprit end, and another on the driver boom, rigged out right aft, and a single rope reeved in three blocks, and made fast to the slings marked 1, 2, in the figure, and just long enough to veer and haul the scrubbers along the bottom fore and aft close to the keel, another rope bent to the lower part of the scrubber, as marked 3, and hauled tight under the bottom, and made fast to the inlode of the boat's main thwart, when the upper part of the scrubber even with the water's edge a-midships on the other side, then the people were ordered to walk fore and aft with the rope to the scrubber, till it came up to the water's edge each way, the boat moving the same way with the scrubber, the people in her helping by putting their hand against the ship's side, till the first depth is thought to be clean enough, then the people in the boat haul by their rope the scrubber a depth lower, by which, and the empty casks, it is confined and pressed to the bottom at the different depths, till it is scrubbed clean down to the keel; and even the keel itself, by the rope going fore and aft under it.

WHEN a ship's bottom can be kept clean by such easy means, I think it should be reckoned a great reproach to those who neglect it, because success may depend upon it, not only in time of war, but in peace on southern voyages, especially in the *African* slave trade, where I have known a ship that lost the whole adventure of her voyage, and came with her bottom covered all over with clusters of mixed shell-fish, projecting from the bottom, and in diameter about six inches each, made up of large barnacles, mussels, and oysters, as represented fig. B, plate 9, which naturally

turally increased greatly the surface and stop-waters of the bottom, and would make the ship sail one half the distance less than she might have done, had her bottom been kept clean as above-mentioned, by which she might have made her passages in half the time, which might have made a gaining instead of so great a losing voyage; for which reasons, rather than such a necessary work should be neglected, I think it should be made a part of the commanders instructions to do it, when it cannot be done by other more effectual means. We had a late instance of a large sharp built ship from *Africa*, in this foul condition, that could not be steered into *Liverpool*, but was lost entirely owing to her bottom not being scrubbed during the voyage. Where iron work is not provided to make a scrubber of this sort of two parts as above-mentioned, I have thought that one part might be made to answer the purpose, and flung with ropes without any iron work.

On the Sailing of Letter of Marque Ships or Privateers.

SITUATIONS, circumstances, and times vary so much, that no established rules can be fixed, yet, I presume something may be said that may prove of some service to inexperienced people in this trade.

IT is a common saying among commanders of ships, that it is better to break their owners than their orders, which are commonly, on their occasions, to proceed with all possible expedition to the delighful stations or tracks of the enemies trading ships, to take prizes, &c. But it should be considered, for the same reason, that their cruising and armed trading ships, may be expected to be met with in the track of our trading ships; which makes it requisite to come to immediate action; and if the ship and people are unprepared for it, for want of being properly stationed, and not having had some exercise in their duty of fighting, as before-mentioned, page 219, it may prove the loss of the whole. And, as a further inducement, to get the ship and people prepared as soon as possible for action, I can say, from fortunate experience, that the *first prize* I have been at the taking of, in the course of two years, was upon the south coast of *Ireland*, which track they had made choice of; to avoid our cruising ships on the *French* coast,

and to meet with some of our merchant ships in their way, one of which they had taken.

On Stationing and Exercising Merchants Ships Crews for War.

FOR the above reasons, the people should, as soon as possible, be all stationed or quartered to the best advantage, according to their capacities ; the oldest and best seamen to be captains of the great guns ; the young, nimble, and expert, to the rigging and tops ; and the boys to be powder carriers for the great guns, &c. and as they come on board, if it is possible that it can be done, they should be exercised accordingly ; and to encourage and make them willing, they should be told, that not only their success, but their safety, as well as liberty, depends upon their being expert in their exercise, which should be with as few, easy, simple words and motions, as possible, both for the great guns and small arms, that they may the sooner be fit for action.

On Exercising Manœuvres ; how to Attack or Defend a Ship.

AS soon as the ship has got to sea, I would recommend what was my practice ; that is, to take the first possible opportunity to have all hands called to quarters ; the officers, in their stations, to have every thing made properly ready and fit for action ; to have a general exercise, not only of the great guns and small arms, as abovementioned, but the method of working and managing the ship, to take the advantage of the openings, that I know, from experience, often occur, in attacking, or being attacked by another single ship ; which should be studied by every commander ; and the designed manœuvres should be taught the people in their general exercise, that they may know how to act, and move regularly from one place and side to the other, as the occasion may require, without confusion, which is always the consequence, when the intention and management of the manœuvres are not known to the people in general.

For these reasons, as soon as possible, I used to make known to them, that when a ship, of nearly equal force, brought to with a desig-

a design to fight us, my intention was not to run directly along side, and lie to like a log, and depend upon mere battering, with one side only; nor upon the stern chase guns. When it is found that there is no choice of running from a ship of much superior force chasing us, and when their best sailing is upon a wind, it is a common practice for them to run up and bring to under the lee, in a triumphant manner, depending on their superior power, and commonly demanding immediate submission, without expecting any resistance. The designed manner of resisting or attacking, I always endeavoured to conceal as long as possible, as mentioned page 205; and these two cases give all the advantages desired by my method. Begin the attack upon the weather quarter, shooting the ship up in the wind, with the helm a lee, till the after lee gun, with which we begin, can be pointed upon the enemy's stern; then fire the lee broadside, as it may be called, as represented in plate the 8th. The ship (figure 1) begins the attack upon the ship (figure 2) when the top-sails are thrown aback, with the helm a lee, boxing the ship round on her heels, as mentioned in box-hauling, page 86, so as to bring the wind so far aft, that the ship may immediately be steered, close under the enemy's stern, as the ship (figure 3) is represented, running under the stern of the ship (figure 4), with particular orders to begin with the foremost gun, to rake them right fore and aft with the great guns, as they pass in that line of direction, all aiming and firing to break the neck or cheeks of the rudder head, the tiller ropes, blocks, &c. so as, if possible, to destroy the steering tackle; which design, if it proves successful, takes the management of their ships from them, so that she must lie helpless, for a time, in spite of their endeavours. When the aftermost gun is fired, put the helm hard a weather to bring the ship by the wind; and then stand off on the other tack, to keep clear of their lee broadside, and act according to their motions, and the experience of the effect your attack has had upon them. If they continue to lie to, either renew the attack again, in the same manner, as soon as the ship will fetch the weather quarter again, or make sail off to escape, if it is found that the great inequality of their superior force admits of no possible chance of conquering them. And although this manœuvre may not have given this advantage (which in my opinion, ought always to be attempted, and not to submit tamely, though a ship is above double the force) yet the power of their broadsides may be chiefly avoided by it.

BUT

BUT when the inequality of force is not so great, but their is a possibility of conquering ; and if the success of the first attack is perceived to oblige the enemy to continue lying to, in order to repair the damage done their rudder or tiller, &c. then the blow should be followed, by renewing the attack again with all possible expedition, in the same manner, which gives the opening, not only to fire the whole round of great guns to advantage, but, also, to the marines and top-men to fire their small arms, at the same time, to great advantage so as to do the most execution possible by firing and raking them fore and aft through their most open and tender part, the stern, with the least risk possible from the enemies guns, and therefore gives the greatest possible chance, that I know of, to make an easy conquest, especially, if so lucky as to destroy, and prevent the recovery of, their steerage. A ship of much superior force may be brought to such a distrest condition as to be obliged to make a submission for want of the helm to command her, therefore when an opportunity offers, in fighting, this should be always aimed at.

BUT suppose the enemy, laid to as abovementioned, find themselves not much hurt by this manœuvre, and that you have not succeeded in destroying their steerage, and therefore you may expect that they will immediately tack, or ware ship, and stand after you, depending on their advantages of sailing faster, and superior force, shall run up along your lee side, expecting by making a general discharge of their small arms and great guns (charged with suitable shot) on your deck, which lies open to them by the ship's heeling, to destroy your people and to make you submit ? When this is likely to be their design, orders should be given to your people to keep themselves as snug under shelter as possible from their small shot, till their general discharge is over ; then if the ship is found not so disabled, but that the top-sails can be thrown aback, make a general discharge, from the lee side, of the great guns, loaded with round shot only, pointed to the weather side of the enemies bottom, amid-ships to one point, at the water edge, and box-haul the ship to run close under their stern, aiming at raking and destroying their steerage, with the other broad side ; then stand off on the other tack as beforementioned, and act according to the circumstance and the condition you find yourselves in, compared with the appearance of that of the enemy and their motions, who may be obliged to continue on the other tack to repair damages about

about their rudder, or to stop their leaks in the weather side of their bottom, if your aim has proved successful.

But when an enemy's ship of force makes only a running fight, if there is no necessity to cut them off from the shore or from the shelter of other ships, &c. and you have the advantage of sailing faster, the most sure and likely method to make an easy conquest with the least hurt to yourselves, or their ship, (your expected prize,) is to run close up and shoot or sheer your ship across their stern each way, making a general discharge of all your force, first with one broad-side, then the other, always aiming with the great guns at the rudder head, and steerage tackling, for the reasons given; that if the shots miss the rudder, &c. by raking the ship fore and aft through the stern, they may do the greatest execution possible to distress them so as to make a submission.

On this occasion, when it blows fresh, and obliges to carry a pressing sail large, or before the wind, to make the great guns as ready as possible, and prevent their being fired too low, all their breeches should be laid quite down in the carriage, and if your ship is crank, the yards should be braced, so as to shiver the sails at the time each broad side is fired.

In all these manœuvres, when the whole round of great guns are designed to be fired, care should be always taken to leave two or more men, as it may require, to charge each gun again when fired on one side, whilst the others move over to fire the guns on the opposite side; that neither side may be left unguarded; all which with every other advantageous manœuvre that may be designed to be put in practice, in action, should be taught the people along with the general exercise of great guns, and small arms (as, before hinted, that I have done), by throwing a tight empty beef cask overboard, making it the object of attack, for all the guns to be pointed at, when performing the above described or other intended manœuvres about it; first, by running a little way large from it; then haul the wind, tack ship, and stand towards it, keeping it about three points on the lee bow till within a half cables length, or musket shot of it; then put the helm a lee, and shoot the ship up in the wind with the top-sails aback, till the after gun can be pointed to the cask; then give the word of command to fire, when there is a fair opening to make a general discharge, both below and aloft on that side, as represented plate the 8th, the ship figure 1, beginning the attack on the weather quarter of the ship figure 2, as before described, which the cask

On exercising with
a cask to point the
guns and fire at.

may

may be supposed to represent, as well as the ship figure 4. When you have box-hauled your ship, and run close past the cask to make a general discharge from the other side, as represented by the ship figure 3, then bear round away from it, ware, and haul the wind on the other tack, till you can tack and fetch up to it again to repeat this, or perform any other manœuvres that may give an advantage to attack or defend a ship laid to, or sailing upon a wind, as abovementioned. To perform the manœuvres of attacking an enemy that makes a running fight large, or before the wind, you have only to turn far enough to windward of the cask, to give room in sailing down to it to bring the ships broadside to point to it each way. But to perform this manœuvre to the greatest advantage, with the least loss of time, and the ship's way through the water, (which may be of great importance on this occasion to keep close up with the enemy) all the great guns should be run out close to the after part of the ports, that they may be pointed as far forward as the sides of the ports will admit, and elevated as the heeling of the ship, when brought to, to fire, may require, as abovementioned. And particular orders should be given for the aftermost guns on each side to be fired first, as soon as they can be brought to bear upon the enemy, because, then the ship need not be brought any more to, but steered in that direction till the other guns are fired; then shift the helm to ware, to bring the other broadside to bear, &c.

AFTER the people have been thus disciplined, it is necessary to let them smell powder, as it is termed. And a little ammunition spent in exercise it is allowed, may be the means to save a great deal expended to little or no purpose, in action; therefore I used to allow a small charge of powder for the round of great guns, with stone ballast for shot; and the musketeers two charges with balls each; and give them a fair chance, by these manœuvres to fire both broadsides, and small arms at the cask; if they sunk it, all hands to have an allowance of grog, as it is called, but if they did not sink it, to have the trouble and mortification to hoist out the boat and fetch it on board to serve another time. By some such methods only, it is possible to make the people expert in their duty to fight a ship to the greatest advantages. But two ships in concert, exercising the different manœuvres, by turns, as might be agreed upon, and making a sham fight with powder only, would contribute most to answer this purpose, and to find out the best trim

trim for their ships for sailing, by the people moving fore and aft with as many shot as they all can carry with them, &c.

ON A SHIP CRUISING IN HER STATION.

SITUATIONS and circumstances are so variable, that no certain rules can be laid down for this purpose: yet I think hints may be given that may contribute towards getting sight of, and falling in with the enemies trading ships, when got into their tract, on which success intirely depends.

CRUISING the war before last in the employ of that great, but unfortunate hero, *Fortunatus Wright*, in the *Mediterranean* sea, where the wind blows, generally either easterly or westerly; that is, either up or down the straits; it was planned, with either of these winds that blew, to steer up or down the common channels ^{On cruising with-} _{out fail in} the common course, large or before the wind in the day time ^{the day,} without any sail set, that the enemy's trading ships, a stern, ^{and under} _{topsails at} erouding sail with this fair wind, might come up in sight, or we _{night.} come in sight of those ships a head that might be turning to windward; and at sunset if nothing appeared to an officer at the mast head, we continued to run five or six leagues as far as could then be seen before we laid the ship to for the night, to prevent the ships a stern coming up and passing out of sight before the morning, or our passing those ships that might be turning to windward; and if nothing appeared to an officer at the mast head at sunrise, we bore away and steered as before. And when the wind blew across the channels that ships could sail their course either up or down, then to keep the ship in a fair way; in the day time to steer the common course under the courses and lower stay-sails; and, in the night, under topsails with the courses in the brails, with all things as ready as possible for action, and to take or leave what we might fall in with in the night.

MANY other advantages attend cruising without any, or but with low, sails set. As abovementioned in the day time and fine weather, when other ships are crowding with all their lofty sails set, they may be seen at twice the distance that you can; which gives you the opportunity to see them a long time before they can see you; and to take their bearing by the compass, and observe how they alter; by which it may be perceivable how they are

Not always to give chase at the first seeing a ship.

steering, and you may consult what is best to be done, if it is too late in the day to give chace; which should always be considered. For three mast ships, in fine weather, with all their lofty sails set, may be seen from each others mast heads seven leagues distance; which must make a seven hours chace, at three miles an hour difference in the ships sailing, which is a great deal with a leading wind; and if the chace happens to be to windward, must make it still longer in proportion of time to come up with her; and when they perceive they are chased, and think themselves in danger of being taken, they will naturally use all possible means to escape out of sight, by altering their course in the dark, if they cannot be got near enough for you to keep sight of them in the night.

FOR these reasons, without the time, situations, circumstances, and appearance require you immediately to give chace with all your sail at the first sight of a vessel, it often happens, that you may stand a much better chance to speak with the vessel by endeavouring to waylay and conceal your design and ship from them; which may be done even in the day time, with all the sails furled as beforementioned, till within about four leagues distance, when it is computed a ships hull, in a clear horizon, begins to appear above it. When this concealment can be made, and all is ready prepared to take or leave, and you can fall in with the expected enemy in the night, or early next morning, if they are found unprepared for action, it must give you a great advantage over them. But when you cannot be concealed from enemies vessels in sight, that may be coming with a fair wind towards you; then it should be considered, whether, instead of giving chace with all your sail set in fine weather, it may not be better to disguise your ship, to appear as an inoffensive neutral ship, by getting your fore and mizen-top-gallant-yards down, and the masts struck with only their heads above the caps, as mentioned page 55, and either stand upon the wind, with the main-top-gallant-tail set, if not noticed, till, by tacking, you can fetch near the intended chace; or, to steer near the same course with them, with stop-waters towed in the water; which I have seen done with success to make the ship sail so comparatively slow as to induce an enemy to come faster up with you, than you could with them by chasing.

IN chasing, all possible pains should be taken to set and trim the sails to the best advantage; as has been mentioned on that subject; and to consider the properties of your ship. If she excels most in sailing upon a wind, the chase should then be kept upon your weather bow, to prevent her getting to leeward of you; but if you excel most in sailing large, and not upon a wind, the chase should be kept upon the lee bow to prevent her getting to windward of you; regulating your motions according to the motions of the chace, that will naturally endeavour to make use of the same advantages of best sailing; and if it is a light ship, or lightly loaded, she will sail better large than upon a wind; and if a deep loaded ship, better upon a wind than large, &c. all which deserve notice. To chase to the best advantage, and as soon as it can be done, the helms-man should see, and be directed, how to keep and steer steady by the chace, (independant of the sun) which is known to help a ship's failing to come up with the chace.

BUT it often happens in chasing, that night comes on; which makes it very uncertain how long, or whether the chace can be seen or not, though many may pretend to see her plain, long after she has been lost sight of by the commander, who should not depend upon other peoples eyes without trying every now and then, whether they point to see the chace, in one and the same part of the horizon, when the ship is privately ordered to be warded about from her course a point or two from the compass each way; and according as they agree or disagree from this rule, either to continue or leave off chase, and crowd sail to get a head, and way lay the chace, in the way she seemed to be bound; which from experience I can say gives the best chance of falling in with her again.

ON TOWING AND ROWING A SHIP IN CHASE.

CHASING with little winds and in calms, may often require both to tow and row the ship with oars. Therefore, to do it in the most advantageous manner, deserves notice. When towing a ship to make her steer and work, it may require the tow rope not only from the bowsprit end, but from the jib-boom end, which will give more power, in proportion as it is farther from the center of the ship's turning motion, to pull her about; but when towing to give the ship most headway possible, the tow rope should

be made fast no higher than is necessary to keep it clear of the water.

To row the ship with oars, the oars should be made suitable to the room the ship affords to row and stow them. In the *Liverpool Privateer*, beforementioned, we rowed with eleven oars on each side; and sculled with two, run out right aft, after the manner of the *Chinese*. And in order to add more power, by more people pulling all together at the oars on each side, and prevent the confusion and hinderance that is occasioned by the people's not pulling all together, we had swiflers for each side, made of single ropes, with gromits in them, at the same distance of the row ports from each other; and put on the handles of the oars so, that men could pull between the oars by these swiflers; which after a little practise, soon made all the people pull completely together.

THE two sculling oars abaft, were made crooked or curved a little, with the flat of their blades bending downwards, and an iron socket nailed to the under part of the oar at the port, when the blade was flat in the water; and a short bolt, tapered and filed like a wood screw, with a round head, was fixed in the middle of the ports for the oars to turn upon; and staples in the deck, right under the handle of the oar that is reeved through with a hole in the handle of the oar that bears the strain, whilst the men scull, by standing on each side of the handle of the oar, and only have to pull to, and push from them, with all their strength, which makes the blade cant and act, flanting downwards into the water, each way, with great power to give the ship headway; and may likewise help to steer the ship and bring her about from one tack to the other, when it cannot be done by the rudder, and will sweep a ship's stern about as occasion may require, when engaging in a calm. The comparative power and effect of sculling oars, to force a vessel through the water, is indisputably proved in *China*; where the people appeared to me no ways expert in their navigation, except in this method of sculling all their numerous river vessels and passage boats, great and small, without any sail or rudder; and this they do in a more dexterous, easy, and expeditious manner, in my opinion, than in any other part of the world that I have seen. I have observed, with pleasure, their vessels with 20 tons of goods, and room to accommodate their families, sculled by two men only, from the city of *Canton* (20 miles) to our ships, stemming and sculling

On sculling-Oars.

On sculling in China.

sculling against the tide, running above two miles an hour, and laying the ship on board in a safe and easy manner. And not only their large river vessels, but their small boats are moved very fast through the water by this method of sculling. I was one in a fine eight oar'd pinnace that was beat with ease, and laughed at by two men in one of their common bumb-boats, in spite of our utmost endeavours; this therefore deserves notice, and might in my opinion be brought into useful practice among us, on many occasions, in boats in narrow rivers and canals, to land numbers of men where there is not room to row with oars; and in our whale boats, &c. for with the very power they scull the vessel a head, they steer her at the same time; which must on this account be much better than a rudder, that stops water, as has been observed on rudders. I cannot forbear here remarking that these Chinese sculling vessels are built upon good principles to answer their purpose, as all vessels that are to be moved with oars or paddles only, ought to be, having flat rounding bottoms, with flanging projecting bows and sterns, without keel, stem or stern-post, to hinder their ready turning; and drawing so little water, they are easily made to skim, in a manner, at a great rate over the surface of it, where the water gives way much easier than it can do at a greater depth; and their method of sculling makes them (as much as possible for art) to imitate the nature of *Porpoises*, which scull with their horizontal tails swifter than any other fish we see at sea, where they frequently seem to sport and mock a ship when sailing at the rate of ten miles an hour, and will swim, as may be observed, sculling with their horizontal tails, across and across the ships bows, at such an angle, that they cannot go less than thirty miles an hour; which must be allowed to make much in favour of the Chinese method of sculling their vessels, instead of rowing them as we do with oars, which are levers; and our method of applying their power in rowing, will in my opinion never be excelled, by any complicated machinery; which has been often tried, at great expence, without success.

On Porpoises
sculling
with their tails.

ON COMING TO ACTION.

NOW we may suppose a ship to have come up so far with her chace, as to perceive them to have the appearance of enemies, and preparing for action. Then the appearance of their force and motions, should be strictly observed by the commanding officer; and he must proceed accordingly, to make all necessary preparations in good time against the worst that may happen; guarding against being surprised unprepared by any sham appearance and motions that may be used to deceive, as happened when I was in a cruizing ship in the war 1746, when the starboard side of our mizen-top was shot away by the enemy before our commander would permit all hands to be called to clear ship for action.

WHEN come so near to the enemy in chace, that they prepare and fire their stern chace guns, (which is a sign of weakness and fear, and which gives joy to the chasing ship) though it must be allowed to give them a chance of shooting away some of our masts, and helps their ship forward; but as success depends entirely upon getting close up, to have them at command, therefore, without some good reason, you should not be tempted to fire your bow-chace guns, because they will stop your ship's headway so much as may occasion the loss of your expected prize.

BUT when the chace is perceived to be a ship of force, preparing and clearing ship for action without running out their stern chace guns; then all possible pains and expedition should be used to clear ship, and make all the necessary preparations, that the circumstances of the time and attack may seem to require; to have the yards slung, the top-sail-sheets stoppered, and to leave nothing to be done but to haul up the courses to come regularly to action.

ON MANOEUVRES IN ACTION.

On running end on to begin the attack **S**UPPOSE you are chasing with the wind large, and that the enemy hauls up his courses and brings to, in form of battle, with the main-top-sail aback, &c. as if he thought it most advantageous to begin the attack by firing his broadside to rake you fore and aft, as you are running down large, right end on towards his broadside, which in my opinion, is a manœuvre that by *Britons* ought never to be refused, though it was given as

a reasonable excuse, for a late unfortunate Admiral's not running right down upon the enemy, who laid to waiting for him; but I can say from reason, as well as experience, that when running right down upon the enemy, we have received two broadsides in the time, without receiving any damage of consequence: for it should be considered, running in that direction, a ship is not above a quarter part as big an object for the enemy to hit, as when broad side to; and the shape of the bows and built making that the strongest part of a ship, may deflect many shot that may hit her in that flanting direction.

THEREFORE I think it a point of duty on this occasion, to run right down, and bring to with the top-fails aback, close on the enemy's weather quarter, and begin the attack by making a general discharge from the lee side; then box haul the ship, and run close under their stern, and make a general discharge from the other side, aiming at raking them fore and aft; and if the power of the enemy appears to require it, put the helm hard over, to bring the ship by the wind on the other tack, till you can fetch the enemy's weather quarter again (if they continue to lie to); then put the ship about, and repeat the attack by the same manœuvre, as before fully described, (as well as that of attacking a ship of force that makes a running fight) in the exercise of these manœuvres beginning at page 228. A fore-stay-sail, as before mentioned, is absolutely necessary for a fighting ship to make her manageable on these occasions, when her courses are brailed up.

BUT it must be allowed, that a ship is liable to be disabled in her masts, yards, rigging, &c. so as often to hinder the performing the above mentioned manœuvre; yet all advantages and openings are to be taken, and none given to the enemy in fighting; and I know from experience, that our people fight much more to advantage, in proportion as they are brought near to the enemy, who we will suppose continues lying to, to fight, and that your ship may be disabled from, or think it necessary to perform the above-mentioned manœuvre; yet even then, I would recommend to begin the attack close upon the enemy's weather quarter, (as the ship figure 1 is represented, attacking the ship figure 2, plate the 8th) and only by backing and filling the sails, as the circumstances of your own, and the enemies ship and people may be observed to require.

IN performing this manœuvre, of backing and filling when the ^{on attack} enemy lays his ship to, to fight, as last mentioned, it should be ^{ing by} _{backing} made

ON MANOEUVRES IN ACTION.

and filling the sails, made a certain rule, on your ship getting sternway by backing the sails, that the helm should be put hard aweather, to make her back the farther a-stern, before she loses her sternway, so as to gain the more room to get sufficient headway upon your ship, to be more under command of the helm to steer and shoot her with pleasure, either on the lee or weather quarter of the enemy, who lying to with their helm a lee, is under no command, but alternately comes to and falls off from the wind; which being observed, you may take the advantage and shoot your ship up in the wind close under and across their stern, raking them fore and aft with what may be called your lee broad side; and after that, the ship may be backed and boxed off at pleasure, to fill and shoot up upon the enemy's lee quarter, to discharge your weather broadside, and back all the sails, especially after sail, with the helm a-weather when the ship gets sternway, to make her back the farther a-stern of the enemy, where all the guns may be loaded again, and all things made properly ready with more safety to repeat the attack in the same manner if the enemy continues to lie to; which may be done by the above management; for in making the stern board with the helm a-weather and the after sails flat aback, your ship rather gains ground to windward, whilst the enemy, with the main-top-sail only aback, drives to leeward, and shoots a head; so that when your sternway is done, by filling your after sails, your ship may be luffed up to fetch and luff up under the enemy's stern again, to act as their situation and behaviour, compared with your own, may admit and require.

THIS manoeuvre of backing and filling, which may be easily continued in practice as long as the masts and yards stand in a three mast ship, gives a great advantage when attacking, or being attacked by sloop, schooner, or any row galley; as vessels, so rigged, cannot back their sails; and then it may be necessary to have both stern and bow chase run out to prevent their raking or running you on board in those unguarded parts.

But let us now suppose that the enemy is found but of equal force to yourselves; yet it is still the duty of all commanders to endeavour by all prudent means, to avoid being unnecessarily exposed to the enemy's shot; and to observe and take all advantages that offer; beginning and continuing the attack by manoeuvres, as long as the enemy's management admits of it, as beforementioned; attacking them close under the stern, and quarters; and not out of bravado, to run up along side to try their strength, until by your superior

superior conduct and bravery, and by appearances, you have weakened and distressed them to such a condition, that it is but reasonable (to save lives and property,) they should make a submission when threatened with your being prepared for and determined in their total destruction, if they refuse to submit.

BUT when an enemy on coming near proves much inferior in force, and stands no common chance to resist your power, then interest as well as humanity to preserve both men and ships from harm, requires to run up to their quarter, and demand immediate submission; but take care always to keep them before your beam, which gives an opportunity to observe their motions and behaviour, and your own people's at the same time, and prevents their taking notice of any of those advantages that have been described, whereby a ship of small force may hurt, or escape from, one of much greater power. And suppose they refuse to submit, and take shelter from your shot in their close quarters, and expect to be boarded to take the advantage to destroy your people from those quarters? Without some very urgent motives, I would never sacrifice men to board them, and fight against the great advantages that close quarters afford, but manage so, as to lay your ship's broadside right across their stern, and there, if possible, to grapple and secure them, by making fast to each of their quarters, and raking them through the stern, fore and aft, to drive them from their close quarters; after which your people may be put on board to take possession; and take their chance to oblige them to make a submission, to prevent farther destruction of the ship or people, which both interest and humanity demand from the conquerors, as far as is consistent with their own safety.

On keeping the enemy always before the beam, and not to board before driving them from their close quarters.

ON TREATING PRISONERS OF WAR.

AFTER enemies submit, and surrender themselves prisoners of war, then not only all hostilities, but treacherous designs should immediately cease on both sides; and for the health and happiness of the whole, while they are obliged to live together in one ship, the prisoners should be treated with all the lenity and liberty that safety and good order will admit of; and not to aggravate and augment their unfortunate situation, by cruel usage and close confinement below, to breed disorder and discontent, and

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drive

ON TREATING PRISONERS OF WAR.

drive them, out of fatal necessity, to desperate attempts for their liberty and to breathe in purer air.

YET it must be allowed, when prisoners of war have their liberty, it requires extraordinary care and caution to guard against giving them any opening or advantage, that may induce them to attempt rising to take your ship from you. In the war 1747, cruising in the *Mediterranean* with the prisoners of three French prizes on board, at their entire liberty upon deck, apprehending no danger from them; upon an occasion, I imprudently ordered all our sails to be clued up, and all our people upon deck, to go up and hand them with all possible expedition; one of the French captains thought to avail himself of the advantage of our people being mostly aloft; I providentially however perceived he was going to give the alarm for his people to rise and take the ship, and putting my hand in my pocket, took hold of my pocket pistol, and ran up close to him, and told him coolly that he should be the first that should die by the attempt; which stopped his proceeding; and I calmly ordered our people to come down as fast as possible; which they did; and made me very thankful to Providence for the escape from this danger; which I thought afterwards, might have been avoided by ordering their seamen to go up aloft, mixed with ours, to do the working part of duty as such occasions may require; which cannot be thought unreasonable whilst they are prisoners of war, and are allowed the same provision and liberty as their conquerors, as far as is consistent with safety.

THEREFORE to enjoy this mutual advantage, all such ungrateful and unfair attempts should be discountenanced and abolished from amongst civilized nations. I farther learned, from this man's attempt, what little dependence is to be put on ceremonious professions: for this man, when first brought on board our ship, made many apologies, and begged that he might not be ill-treated for the resistance he made in defending his ship; and he was answered, that he should be treated rather better than worse for doing his duty like a brave and honest man.

THIS

THIS is of such importance to navigation, as to deserve notice, whether any, or how far such signs or sayings may be observed or depended upon from experience, to be of any use to seamen.

IT must be allowed that our world, and system of worlds, and the whole creation, as far as we can observe, are governed by the ALMIGHTY CREATOR, present to all parts, which are moved by his general laws, so as to be subservient to answer all the just purposes, not only of his general, but superintending, special Providence. Yet we are told, by Revelation, that our ever BLESSED SAVIOUR, Lord of the World, who shewed his command of the elements of winds and waves and all nature, as far as we know, and said the wind bloweth where it listeth, but from whence it came, or where it went we knew not. And accused the Jews who would not discern the signs of the times as foretold respecting himself, although they attended to the signs of the weather by observations. "When the sky was red in the evening, "a sign of fair weather; but when red and lowering in the "morning, a sign of foul weather; when seeing a cloud rise out "of the west, there cometh a shower; and so it is. And when "the south wind blows, there will be heat, and it cometh to pass." And these signs are continued to be observed here to this day. And St. Paul in his voyage to Rome, in the season of the year when sailing was become dangerous, told what would be the consequence to the Centurion, who believed the owner and master of the ship more than St. Paul; and when the south wind blew softly, thought they had obtained their purpose; but it was attended not only with great hardships, and loss of the ship and cargo, but a narrow providential escape of their lives, as foretold by St. Paul.

For these reasons, all that is known from experience either from the barometer, signs, or sayings, that may any way contribute to point out to seamen the weather and winds likely to happen, deserves mentioning at least, to make them more familiar to observation, and how they may answer.

IN the torrid zone and near the tropicks, it has often been remarked by the learned, that both winds and weather are mostly periodical at different seasons of the year; and the barometer varies but very little; but in higher latitudes both north and south, like the winds and weather it varies greatly all the year round, as mentioned in the first six pages. I must own, during the many years

obsevations I have made of the barometer, I have often been disappointed in expecting an easterly wind from the glass being high; which I find happens with westerly as well as all other winds, and that a quick rise as well as the quick fall of the quick-silver shews changeable and uncertain weather. And that these changes of weather and winds no way depend upon the situation or phases of the moon, or the sun at the equinoxes, as they are too generally thought to do in this climate. And it has been lately remarked in the philosophical remarks of the Royal Society, that what are called *influenced times*, have no effect to occasion changes of wind and weather, and they happen at those times no more than at others; therefore I think those prejudicial notions ought to be exploded, especially those that deter ships from going to sea till the equinoctial gales are over, at which times I can say from memory, and an exact Journal kept for 28 years, of winds, their velocity according to Mr. Smeatons Tables, and weather and every thing that could affect the tides; in making observations on them, that we have as fine weather at the equinoxes as at other times, as by theory, we ought to expect it, because it is then only that the sun shines upon our globe from pole to pole as particularly described page 123, which should naturally tend to equalise the temperature of our air, rather to prevent than to raise storms.

FROM what has been said on this subject, it is not to be doubted, but that alterations are made in the density of the different parts of the atmosphere, that may cause the elements to move so as to give the appearances in the sky, from which these signs and sayings had their rise. "The evening red, and the morning gray, is the sign of a fine day. A clear N. W. and a foul S. E. horizon, a fisherman's night. A rainbow or weather-gall, at morn, fine weather all gone. But a rainbow towards night, fair weather in sight." It is reckoned a bad sign when terrestrial objects, at a distance, appear extraordinary clear and near; and when the stars appear very numerous and glaring the first of the night; and when a great white frost appears in the morning.

RELATING TO WINDS. "When the sun sets clear, an easterly wind you need not fear. When the sun sets under a bank, a westerly wind you need not want. When the wind blows cold, it is likely to hold. An easterly wind right, commonly abates at night." Our frequent long westerly gales commonly end in varying about to the northward; but when the wind backs

backs (against the sun as it is called) to the southward in the afternoon, it is a sign of bad weather and the gale continuing. "At coming on of squally and blowing weather, when the wind comes before the rain, lower down the topsails and hoist them again. But when the rain comes before the wind, first reef, "and then hand."

BUT to fail from a port or road-stead, or carrying sail at sea in suspicious weather, it must be left to the commander to form a judgment to act as appearance, situation, and circumstances may require. Yet I cannot help remarking, I have known many great, fatal, and total losses by sailing with southerly winds, with drizzling rain; especially in the winter season; which, in this climate for seamen, may be reckoned to begin with *October* and end in *March*; when the wind, from being moderate at S. S. E. afterward flies about suddenly to the westward, and to N. N. W. the opposite point of the compass, and blows with such violence, as to do great damage, and is very destructive to shipping, when they are caught unprepared, with a great deal of sail set. Besides that storm, mentioned pages 5, 6 I have known many others that have been very destructive; and one in particular, that deserves notice, as discouragement to that vile cruel practice of pressing seamen for government's service. In the latter part of the foreign war, 1757, in the evening, I saw one of his Majesty's ships of war with all sail set crowding away with a large wind at S. S. E. and rainy weather, with about 140 pressed men on board. That night the wind flew suddenly round to the opposite point N. N. W. and blew a storm that must have overthrown and sunk her, for no remains were ever found, but her barge, that had floated off the booms. So that with a southerly wind and rain, ships should be upon their guard, and not be covetous of the weather shore, for fear it may suddenly prove a dangerous lee one on our coasts.

ON SHIPS IN DISTRESS.

SUDDELY distress of ships at sea, has often struck their crews with such panicks as to occasion them, in many instances, to take the worst, instead of the best means or methods for their safety or relief; their minds being so discomposed, at such times. As physicians when sick, are reckoned very unfit to prescribe

ON DANGEROUS LEAKS SUDDENLY BREAKING OUT.

prescribe for themselves ; therefore every endeavour should be used to point out every thing that is thought possible to be of any service on these melancholy occasions, as far as circumstances and situation can be described to happen. For it is but too well known that many people, after suffering great hardships, have lost their lives, by two rashly quitting their ships in their boats, when they might have been saved if they had staid by their ships.

When a ship proves weak, and works the oakum out, so as to make dangerous leaks between wind and water, it is common to nail sheet lead upon the seams, I can say from experience, that lead breaks by the ship's working, especially when she hauls under the chains, (as it is called) by the strain of the masts and shrouds making the seams open and shut as the ship rolls. Leather or canvas, nailed on slack, with oakum under, will answer the purpose much better than lead.

ON DANGEROUS LEAKS SUDDENLY BREAKING OUT.

AS soon as the pumps are manned and set to work, the utmost endeavours should be immediately used, and all possible means tried, to find out and stop the leak, before the people become jaded by pumping ; which, from experience I can say, gives a much better chance for safety than a continual pumping, which may prove ineffectual, without endeavouring to stop the leak.

On Fothering, to Stop Dangerous Leaks in Ships bottoms ;
and their Pumps.

IWAS in a ship called the PEARL, as mentioned page 24, that had but been three voyages to the East Indies, that was armed and fitted out at *London*, to cruise three months off the Western Islands, where in a great storm the step of our foremast gave way, by its not being bolted through the timbers, but through the rooms between them, that the bolts worked great leaks in the outside planks, which great fault of the builder deserves particular notice, and being so low in the bottom the water rushed in with great

great violence on both sides of the kelson, which made it the more dangerous for the reasons given page 10, which obliged us to set all our pumps to work with the utmost exertion, till we got the spritail unbent and stitched over with bunches of oakum with ropes to the clues for the fore part and carines, for the after part applied it to stanch the leaks, which stoped them for a time, till we freed the ship from water, and made sail for Lisbon, and got repaired by heaving keel out, which proves the spritail well adapted for forthering ships bottoms by being made strong to bear washing and may be easily spared for this important purpose.

ON SHIPS PUMPS.

WE had two chain pumps and two wood sucking pumps in this ship; though the third officer in command, I joined a gang at a chain pump on this important occasion, to shew an example to the people, pumped with a swift motion half an hour at a spell, by the half hour glass, when those at the sucking pumps could not continue striking them above five minutes at a spell, by the pump brakes working breast high, which soon tires the arms and greatly fatigues the men working them. Therefore chain pumps for ships where there is sufficient room and men to work them, will always have the preference by going round all one way makes a perpetual lift and discharge of water in proportion to the swiftness of the motion they are worked with, which in my opinion excels all the others that I have seen.

After all the commendable trials of late that have been made to improve ships pumps, yet the lead and wood sucking pumps are in general use even in capital merchant's ships, therefore, I shall endeavour to relate what has occurred to me on this important subject.

INSTEAD of working these pumps in the common tiresome method with a single brake breast high, as abovementioned, I would recommend to make a long square cistern of two inch oak plank, 26 inches long, 12 broad and 12 deep, with a partition in the middle, that the two end squares may admit two lead pumps to go through their bottoms into the well on each side of the kelson, and their lead spouts pointing through the fore side of the wood cistern, or fixed on the top of two wood pumps with an iron stand

stand exactly in the middle, with cheeks and holes that a pump bolt may go through, what I call a double iron brake as a fulcrum or prop that it turns upon, and having a slit on each side right above the bores of the pumps, with holes for the shanks and bolts for the upper boxes, with wood handles at each end, and to be no higher than it can be worked with what I call, underhand pumping, that the men by pulling upwards can pull twice their weight, and by pressing downward can easily press their whole weight, so that when occasion requires to work two pumps they make a double stroke, that makes two strokes for one in the common way, as may be better perceived on referring to plate the 2d, which describes a pump I got made of two inch fir boards, to pump up the water, whilst making tunnels for our Wet Docks to wash the mud out of each other.

THIS pump was made from observations on the principles of the pressure of our air, as mentioned page 3, how boys lifted paving stones with their small round suckers; to try the experiment, I got my shoe-maker to make me two of them, three inches diameter of tanned hide, called butt, that lifted a paving stone that weighed fifty six pounds, and by stilyards the same weight, when tried to hearthstones, which is equal to the weight of seven gallons of water. I made the two suckers for the vacuum of this pump of the same sort of leather, 12 inches square, nailed to a square frame an inch thick, that exactly fitted and put down upon battons nailed tight, six inches from the top of the two squares, which made them both air and water tight below. And the main pipe to go down into the water or well, was made of straight flat boards, open four inches square at the bottom, and nine inches by four square at the top, and the partition board going down in the middle when it was fixed fast, with the plain of the bottom, about 18 inches, left a square opening of about four inches into each cistern, on which was fixed a valve on each side of the partition, that opened and shut as the pump was worked by two square valves fixed in the middle of each leather sucker, with four square thin iron plates about an inch broad, with holes at each corner for four small branches of the pump rod to go through, with screws and nuts below to fasten the leather and upper valve or clapper, which not only made as long a stroke up and down as common sucking pumps, but by the bending of the leather up and down, added greatly to the vacuum and made two strokes to one common pump, and discharged a great deal of water without any friction.

And

AND either common lead or wood sucking pumps may be worked in this manner to great advantage, as before mentioned. A large ship that was built here for the *German East India company*, had four wood sucking pumps worked upon this principle, to work one, two, three, or all four by this under hand stroke.

I CANNOT help thinking that if what I call double sucking pumps were well made of oak plank, as above described, they would surpass all other single sucking pumps; for if it is considered that so small a conical vacuum is made by a three inch sucker, what may be made by 12 or 15 inch square suckers, lifting and discharging two strokes for one. And two of these pumps may be made to stand very well, with the iron brakes of the upright stands of the cisterns, together a midships in a straight line fore and aft, abaft the mainmast, one cistern discharging the water forward the other aft, the upper valves opening that way.

THE cisterns standing upon a level, with their upright iron stands of equal height and length, that long wood handles may be put through the eyes of the brakes on each side, to work both pumps together when occasion requires it. But it requires care that the cisterns are fixed at the top of the pipes, exactly with that small angle to admit the lower end of them to go down on each side of the kelson, with cleats upon them, to rest upon the kelson, to keep them at the proper height from the bottom of the well. The thickness of the plank for these pipes I recommend the two side pieces that are to be four inches broad, from top to bottom, to be two inches thick, but the two fore and after pieces that are to be six inches broad at the bottom, to fourteen inches at top, to be from 2½ to three inches thick according to the size of the vessel, and rounded off a little at the corners that iron hoops may drive well upon them, and especially one near the top, with two holes in the middle that a small bolt may pass through, and the tongues of the cisterns, four inches broad to go down the middle of the pipes about eighteen inches, when the tops of them are cut to two inches, that the bottom of the cisterns may be fitted tight even with the top of the pipes, and properly bolted with small metal bolts, nuts, and screws, to keep them so; I would gladly contribute something handsome to give them a fair trial for ships, for it must be allowed, that even great geniuses cannot see all that is against them in new things till experience decides.

BUT the performance of the deal pump made and nailed together in a cursory cheap manner, by our common dock carpenters,

ters, as mentioned page 248, and represented plate the 2d, I was induced by the advice of some friends to send it up to *London*, to take its chance for the premium that was then offered, by the *Noble Society*, for *Arts*, &c. for the best pumps for ships, which I did in a waggon, and went up to see the trial, at the time appointed, when there appeared only two other on the occasion, one of them was a round of water buckets to a chain going on a barrel like a chain pump, which was objected to as not fit for ships; the other was three common wood sucking pumps fixed close together in a straight line, the upper boxes were worked by three iron cranks, that were turned round with a long winch the same as a chain pump, which three pumps were fixed and tried against mine, on board of a ship in the *River*, which I must own by the swiftness of the motion of working these three pumps united all one way, made them to appear to discharge more water than mine, but the difference was not ascertained, no method was made for that purpose.

AFTER the trial I waited upon the *Society* for their decision, which was, that none of the pumps that appeared, deserved the premium. I then sent my pump home by a *Liverpool* trading ship.

IF they are to be tried on board small vessels exposed to a hot sun, in warm weather, that may cause the cisterns to shrink, it may be necessary to nail pump leather on the out side of what may be called the seams of the cisterns, to keep them air tight, if they come to be in common practice, and worked upon the upper deck, additional power may be easily made, of iron bent like a swan's neck, to be put occasionally with a small bolt to the ends of the brakes, with an eye at the upper end, above head, at a proper distance, for men to pump with bell ropes, which from experience I can say easily increased the discharge of water; this and many other advantages, in my opinion, would attend these pumps, above both the common wood and lead sucking pumps, which discharge most water in proportion to the tightness of the leathers of the upper boxes, and that increases the friction in proportion to require more power to work them, and when worked laid for any long time, not only soon wears away the leathers of the upper boxes, but the bores of the pumps, lead as well as wood to require ryming, which I think cannot be got done at sea.

BUT

BUT if these plank pumps were brought into use, they might not only be repaired, but made on board ships at sea, if they have the materials, which would be neither expensive nor cumbersome, and not liable to be choked as the other fucking pumps are, by which ships have been lost.

On Seamen Quitting their SHIPS too soon, to save themselves
in their Boats.

SOME late accidents happened on our neighbouring coast, when it was thought the crews of some vessels had left them, and took to their boats to save themselves too soon, when it was thought, and in a manner proved, that they had time enough to run for a port or on shore, where themselves and vessel might have been saved, or property from them, for one of them was a brig leaden with coals from *Liverpool*, who boarded a vessel in their boat that was bound to *Liverpool*, saying their vessel had struck upon a rock or a wreck, that obliged them to quit her.

The master of the vessel bound here took them on board very reluctantly, saying, he thought they were *Liverpool* pilots, or he would not have stayed for them, when these wrecked people got to *Liverpool*, they complained in a newspaper, that they had been ill treated and put to shamefull short allowance in their passage here. This was contradicted, and a report made, another vessel that had seen this vessel driving a float sixteen hours after she had been quitted.

THIS occasioned a just remark in one of our newspapers, that as the water increases in the inside of the vessel above the leak, the leak decreases. And another advantage may be added to it, that the pumps work easier and discharge more water in proportion as they have less height to lift it.

THESE reasons prove the necessity on all such important occasions, to try not only the utmost power of the pumps and all other possible means, before they quit their ships and take to their boats for safety, which often proves fatal; and when the pumps are got fairly set to work, it is wrong to depend upon a continual pumping without endeavouring to stop the leak, therefore, all the other part of the crew that can be spared from pumping, should exert their utmost possible endeavours to stop the leak, and if it

cannot be done within board, and too low under water to do it without board, then to try to stow it with some strong staysail such as the main, fore, or fore-top-mast-stay-sail, or sprit-sail stowed with oakum, as mentioned page 247, and if there is not spare oakum, it may be soon made from rope.

WHERE so many valuable lives and property are at stake, this becomes a serious subject to give advice upon; yet I think whatever vulgar errors tend to raise groundless fears on such important occasions, as much as possible ought to be exploded and abolished, and I take that prejudiced notion to be one; that when a ship sinks, she makes so great a vortex or whirlpool above her, as to swallow up any vessel that is near her; which from the nature of things in this case, I think cannot be true for the following reasons.

IT is well known, that all ship's upper works are lighter and more buoyant than their bottom parts, which are more water soaked and heavier, and the center of gravity of ships, and all that they contain presses upon the bottom near the midships or main frame, which must naturally sink first, as it is the known property of bodies pressed through fluids, lighter than themselves to go with the center of gravity first, as mentioned page 66, the bottom being of a convex form, the lower part of the deck or decks being of concave form that makes a greater resistance, which makes ships sink gradually upright nearly as they swim, without making any vortex or whirlpool, that the boat or boats may be floated off the deck without danger. We had a late instance since I wrote the above, mentioned in our newspapers, of a vessel that was sunk suddenly by another vessel, when the pilot, whom I examined on the occasion, cut the boats gripe when the floated off the deck, and the crew got into her and saved themselves, which confirms my opinion to be right.

THIS loss happened from two ships standing upon a wind on different tacks, when both expecting to weather the other, they called to each other to bear away, which they both happened to do at the same time, by which they run with the greater force on board each other, that the one, whose crew saved themselves in their boat, immediately sunk.

On Ships running on board each other, when sailing upon a wind on different tacks.

SUCH great destruction so often made on such valuable lives and property, by such daring obstinacy on these desperate occasions, certainly deserves an attempt at least to prevent as much as possible, the fatal losses that attend so many of our own ships.

SUPPOSE a Rule or Law could be made by the Admiralty, that in all doubtful cases, on these dangerous occasions, that when ships on the larboard tack cannot be sure of weathering the ships on the starboard tack, to be obliged to bear away under their sterns or put about in good time to prevent running on board them, or be made liable to all damages.

ON A SHIP OVERSET, OR LAID ON HER SIDE, AT SEA.

TO recover and get a ship upright from this dismal and dangerous situation with the least damage possible, is certainly a task that deserves the utmost attention.

THE most common method is, to cut away the ship's masts, especially the main and mizen masts, in order to make her ware and bring the wind on the other side. But reason, as well as experience, has often proved, that this desperate, and expensive method, has not answered the purpose. For the ship's hull in that position, greatly becalms the masts, especially the lower masts and sails, and prevents the rudder from having such effect upon the water as to make the ship ware. In further confirmation of this, I was told by a commander that put this desperate remedy in practice, that it would not have answered the design, if it had not happened, from an accident, that some of the lower standing rigging on the lee side being omitted to be cut, brought the masts up, and made such stop waters on the lee quarter, as, only, caused the ship to ware.

I HAVE heard of another accident, that recovered a light coal ship that had canted her ballast at sea, and overset so low on her side, that the bower anchor happened by chance to go from the lee bow, and the cable running out, it took hold in the ground, so as to bring the wind a head, which took the sails aback, and cast

cast the ship on the other tack, when they soon got her trimmed upright again. I was in a light coal ship that hove out all her ballast at sea with a scant wind to sail into *Tinmouth* haven, where the pilots as well as seamen are the most dexterous in the world. In narrow channels these men, for the good reason of making their ships sure in stays always work them with their mainsail, and all the sail that they can carry set. When we came to haul our ship by the wind, she laid down on her side, so as to bring her keel and rudder out of the water, to windward. Our pilot had the presence of mind to let go the lee anchor, which brought the ship round to, with the wind on the other bow that took the sails aback, as they were sharp braced up; this immediately brought the ship upright again; so that we hauled up the courses, hove up the anchor, and drove to windward into the harbour with the tide; backing and filling under our topsails, without any damage.

On Recovering a SHIP upright, without cutting away the Masts.

THE above instances evidently point out what at least should be tried on these dreadful occasions. If ground is to be reached, by any means, the lee anchor, or anchors, should be immediately let go, if it is possible to bring the wind upon that bow that is laid down; then the wind may act upon the masts and sails that may be set so as to bring the ship upright again, as above-mentioned; which may be called *club-hauling* a ship, to get her from one tack to the other, as mentioned page 87. But in deep water, where anchors can be of no service, I would recommend, that if a tow-line, hawser, or cable end, can be readily come at; and if the driver boom, hen coops, or any other bulky things can be flung by the middle with ropes, and made fast to it, or even the driver or any other sail with the clues stopped so as to make a drag sail, and veered away with a long scope over the lee quarter, to make such great stop-waters as to make the ship ware, and bring the wind on that quarter that is down, that the ship may be brought to on the other tack, and the sails trimmed, so as to get her upright again without cutting away the masts; which nothing can justify but the utmost necessity, to save a ship from foundering, because of the great distress it brings the ship under, for want of her masts; especially her lower masts; when they may have a long

long run to their designed port, or to a place where they can get this great damage repaired. And many late instances have occurred where the masts have stove the vessel's sides before they could be got clear of.

To make a SHIP ware and steer that has lost her Foremast.

TO do this, must be of the utmost consequence to a ship meeting with this misfortune in a dangerous situation. Therefore I venture to give my opinion, that this may be done by the last mentioned method, that is, by veering a hawser or cable end over the lee quarter, but without any flop-waters, only the nun buoys, david, or any spare spars, masts, or yards, lashed along it, to buoy it from taking the ground in case of coming into shoal water, with little wind. This will act with great power, with the helm, to make the ship ware and steer at pleasure. And a spare yard or boom, may be rigged out abaft the mizen shrouds to guy the tow, more or less on either quarter, according as the ship may have occasion to fail, and that makes her gripe more or less on the helm, so as to require it. It may be easily shifted from side to side, to answer sailing upon both tacks, to be guyed the more to leeward in proportion to the ship's gripping; and when sailing before the wind to secure it over the middle of the stern, will prevent the ship broaching to against the helm both ways. And this would answer the purpose to make a deep loaded bad steering ship steer better, and prevent her broaching to either way, in spite of the best helmsmen, on which account they are sometimes obliged to lie to with a fair wind, as I was told by the commander of a ship (who was an expert seaman and a good commanding officer) he was often obliged to do.

ON STEERING A SHIP THAT HAS LOST HER RUDDER.

IWOULD propose on this occasion, a hawser or cable end, ^{On fore-} with the nun buoys, spare spars, masts, or yards, lashed along ^{ing & flop} it, to buoy it up, in case of coming into shoal water; and a boom ^{with a cap} ^{block's end.} rigged out on each side, close aft athwart the stern, with the block

on

on each, at equal distances, as far as they can be supported from the stern; and a block on the rail or gunnel, exactly opposite the middle of the barrel, of the wheel, where the steering rope, marked with a rope yarn in the middle, is to be taken with three or five turns round the wheel when the midship spoke, and the mark on the rope, are right up; then the two ends to be passed across from the under part of the wheel, and reeved through the blocks on each side, and made fast to the hawser, or cable that is towed a stern exactly a midships, and as tight as it can well be to go clear of the stern; and then veer and heave freely from side to side, as the steering of the ship, with the trimming of the sails on this occasion, may require.

The wheel rope leading under the barrel of the wheel on this occasion, gives a great advantage; because the wheel is to be hove round the same way as when the rudder was in its place; so that the ship may be cunned starboard, and port, luff and no near, hard a weather, or hard a lee, as occasion may require; for turning the wheel to put the helm a port, heaves the towing machine up to the block on the starboard quarter, which flops water on that side, and brings the ship's head that way, and acts with the same power when hove over to the other side, &c. which is the readiest and best *make-shift* that I know for this purpose, when no other help can be had. And should this misfortune happen to a vessel that has not a steering wheel, it requires no great labour or ingenuity to make such a *make-shift wheel* of a boat's windlass, or winch, or other materials that may be found on board; and to fix it abaft the binnacle, as the best place to answer the purpose.

BUT when it happens that help and assistance can be had from other vessels on this occasion, I think it necessary to remark here, that I have known ships that have lost their rudders on the sand banks at *Liverpool*, that have been steered through narrow dangerous channels, by two pilot sloops; one with all her sails set, leaching and towing in a fair way, with a rope a head of the ship, which had but little sail set, and that trimmed, as occasion required; whilst the other pilot sloop, with a rope from each quarter, was towed a stern of the ship without any, or but occasional, sail ready to set to steer, and sheer her with the helm on each quarter of the ship, as the occasion required, to cause her to follow the leading sloop in a fair way, till towed into safety.

On steering a ship with two sloops.

Captain PECKENHAM's Make Shift RUDDER as here described, supersedes all other contrivances when it can be made from the materials on board.

IN reading the seventh volume of the transactions of that most noble institution, the Society of Arts ; manufactures and commerce. I was highly delighted to see made publick in a genteel generous and masterly manner, with the plate of Captain Peckenham in our royal navy, ingenious contrivance of making a substitute for a ship's rudder, from his ship's stores, and gave it a fair trial. And the value of this important discovery is further, and I think sufficiently confirmed by the report of Captain Cornwallis and his officers, who made one on board the CROWN 64 gun ship, when they lost their rudder by the above description, that answered so well, they thought it sufficient to steer a ship to any part of the world. And the monthly Review, which I have taken in many years, for December 1789, page 533, thought the discovery of this importance to seafaring men, shoud certainly be published by itself, in a low priced pamphlet, with a plate, and a full description, that it might fall in the way of all Commanders of ships, &c.

THESE reasons, and the very great distressed state men must be in, in a ship on that dangerous element without a rudder, induced me to get Mr. Joseph Elliott, who drafted the ship HALL, built for the Jamaica trade, as mentioned page 38, to go on board her with her commander and others that was pleased with the design, to examine what stores could be found on board to answer the purpose of making a make-shift rudder, in case of a misfortune, it should be wanted. First, we found a spare main-top-mast for what may be called the main piece; Second, next to it two pieces from a long pole called the derrick, by which they hoist goods in and out, and the spritsail yard, which might be easily spared on such an important occasion cut in two, and these fayed and fastened to the main piece, and each other with peggs or small fir treenails, with a board at top, and one on each side fayed to the top-mast, and close to these boards a wooden round all, another board cut so as to give room for the rudder to traverse freely round the round part of the cap, with two wooldens above and below it round all, and a board nailed on each side at the lower part of the rudder, with a woolden above it, as may be observed by the plate drawn from a proportional model, made it as big as the HALL's rudder.

BUT it is not usual for these ships to carry a spare main cap as they do in our navy, though they come very dear when wanted to be made abroad, therefore I think it worth while to carry one, if that should be the case, it should be without bolts across the after part, and fairly marked to fit the proper place of the sternpost and run of the ship, that the after part of the cap may be cut so as to answer this important purpose, if occasion should require it, to make what I call the lower rudder band, as one of the anchor-stocks, is to make the upper one, and instead of using the bolts of the cap, to confine it to its place as in the original. I would recommend to leave room clear of iron, that a groove may be cut to suit the size of the rope designed to go round the cap, with a woolden round that rope, on the solid part of the cap to strengthen it, and keeps the rope in its place, that are to be boused tight through the hause-holes to keep it in its place, as may be seen by the plate. And how the ropes lead along the body of a well formed freight ship, to confine this lower band firm to its place. The upper band, which is to be made from the greatest anchor stock, in this ship it was not found thick enough, but required some two inch board in the inside, to make what I call a round collar just fit for the round part of the top-mast made to traverse in below the rudder head, all which should be made as perfect and ready as possible, that the anchor-stock may be trenailed together and fixed secure on the deck, where it is to be fastened a cross, and if the anchor-stock hoops should be too small for the rudder head, it may be woolded above and below the tiller hole to strengthen it.

HAVING proceeded thus far in this model of mine, as well as in the original, as may be seen in the excellent book mentioned, that this make-shift rudder is fixed so far from the stern-post, that makes it liable to be hurt and damaged by ropes getting into the heel, as it is called, that may haul the lower part away, to prevent which, and to give greater security to the rudder, I recommended to add what I call a sole, fixed to the bottom of it, suppose about two inches thick, with a small square end, to be made at the lower end of the top-mast, and the other three pieces that make the rudder be tenanted through it, and the fore end round to a sweep of a circle from the center of the lower end of the top-mast, which is the center of motion of this rudder, and just so broad as to touch the stern-post slightly, as the rudder traverses to three points of the compass each way. And another rope like that round

round the cap, round the bottom of the rudder with a clove hitch, just above the sole, leading along the ship's bottom, tight through the hawseholes, with the lower part of the sole, at least six inches above the lower part of the keel close to the stern-post, by which it may be secured from damage, and traverse sufficiently each way to steer the ship.

THIS hint of having a rope with a clove hitch put to the bottom of the rudder, in case of the lower rudder bands giving way, was recommended to my notice many years ago, by an old ingenious ship master. And I saw an instance of one of our *Jamaica* ships homeward bound in the *Gulf of Florida*, that had all the brass pointed bands of her rudder broke,* but having an iron one above water held. And by unhooking the rudder and putting a rope with a clove hitch at the bottom of it, and boused tight to the lower part of the fore main chain plates on each side, which answered to steer her home very well, and even through a very narrow passage which is called our dock guts at *Liverpool*.

I HOPE these last remarks will be allowed to shew the advantage of a sole and a rope to the bottom of a makeshift rudder, which I hope to be excused recommending to the consideration of the gentlemen of our incomparable navy, who have it most in their power to get a fair trial made of them, and in my opinion it most concerns them, as being not only liable to accidents by shoals, &c. as was the case of Captain *Cornwallis*, but also in action in single combat between two ships from an enemy, which used to be my aim and orders, as I have endeavoured to describe page 229, and represented plate 8th, by manoeuvring to endeavour to run close under the stern to rake the ship, and by firing at the rudder to disable their steerage, when that can be done, it gives the greatest advantage over an enemy, either to take, or leave a ship of superior force.

To make further trial of this rudder, I got Mr. *Ellist* to draft and draw a ship on the principles as described page 43, shews it plainly, by the curve of the bottom and keel of these ships at the fore foot, and heel, being so much above the level, that they must naturally fit upon the ground, and when afloat, swim mostly where the water presses most upwards under the midship or main frame, that may be called the crown of the elliptical arch of their bottom that

* I think they may be very properly called by the modest name of pointed rudder bands, when made of either brass or iron, to endeavour to abolish that most vulgar obscene name pintles, which we so shamefully give them.

produces so many good properties as has been often mentioned. I got a model of a ship made with a make-shift rudder fixed to it, with the ropes leading along the body of the ship to the hauseholes, and the helm 33 degrees to, or hard aport, as represented in the plate, which I hope will contribute to form ideas or notions how make-shift rudders may be bestgot made in distress and on important occasions.

But merchant's ships not carrying cast iron pig ballast, as they do in our navy, to put to the bottom of this rudder as represented in the original, it requires consideration how to do without it. I form a notion if the iron ballast was only used to sink the rudder low enough to get it hung, and prevent its rising after it is hung.

THE greatest difficulty attending this, appears to me, to get the rudder properly sunk low enough for this purpose, therefore in my opinion, some methods ought to be pointed out, though they may not prove equal to what may be suggested to men of common resources, under such great necessity, which is allowed to be the mother of the best inventions. Yet I venture to propose any small anchor slung by a rope, with a clove hitch to its crown, long enough to go up each side tight from the bottom to the top of the broad part of the rudder, close to the after part of the main piece, and made tight fast to confine the anchor close to the sole, till the rudder head is got entered into its place, then the anchor may be let go from it, and take it on board; or it may be done in the same way by a graplin, with a rope made fast with a clove hitch to its ring, and bags of Ballast or any heavy stores made fast to it. And when the rudder head is got to its proper place, the ropes round the cap and the bottom of the rudder may be boued tight through the hause-holes to the pall bits, &c. till the anchor-stock, formed like a collar, is properly fixed to go round what I call the neck of the rudder, and secured athwart in its place that makes the upper band for it.

To prevent this rudder from rising, there is not only the shoulders as they may be called under the anchor stock and cap, but a hole may be bored through the stern-post an inch or two below the upper broad part of the rudder, with a rope strap through it, to go round the main piece, just slack enough to let it traverse as may be seen by plate of the rudder.

I MUST own it hurts my feelings, to hear people make difficulties to get useful improvements done, when they must allow that what one or more men has done, others may do, if they take the same pains with equal resources.

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On the Danger of a Lee Shore in a Gale of Wind when the Waves run high.

OF all the dangers at sea, this is generally allowed to be the greatest; and most people pity seamen when in a gale of wind, but none so much as those who know from experience the hardships they go through in cold weather, long dark winter nights, dangerous situations, and near a lee shore, especially if it is a rocky one; when the waves run high it is most to be dreaded, and the utmost endeavours should be used to keep from it, because it gives little or no chance of saving either the ship or the lives of even the best of swimmers.

I KNEW a melancholy instance of this. Two *Algerine* ships of war were drove on shore with a S. W. gale of wind on the S. W. coast of the island of *Misra*, and both ships wore immediately beat to pieces, and the people, about 800 in number, though the best of swimmers, were all drowned, or rather killed by the waves dashing them against the rocks, except one man, who, upon a piece of wreck, happened to be thrown so high upon the shore as to get out of the back sweep of the waves, which waves killed the others, as might be observed by the bruised wounds on their bodies; though this rocky shore was not so steep, but I could walk up and down it upon my feet without using my hands to support myself.

To avoid such fatal consequences as these, which often attend ships going upon a lee shore, every possible effort of mind and body should be exerted and tried to preferre and keep the ships off from the shore, as being the only chance to save the lives of the crews, and the property that is under their charge; by which conduct, only, it is that the hardy and brave officers and seamen can be distinguished from the soft, cowardly lubbers, who give themselves and the ship up in a cowardly manner to go on shore, rather than undergo the hardship of being obliged to contend with the weather, wind, and waves, which it is certainly their duty to do as long as there is the least appearance of a chance by any means to avoid the dreadful danger; and by which only it is, that they can reasonably expect Providence to favour them; for it is an alledged maxim in common life, that it is to little purpose to endeavour to help those who will not endeavour to help themselves, and we too often meet with dastardly lazy skulkers at sea, who, when obliged to be exposed to the weather, for want of resolution to rouse and exert themselves, become so feeble and helpless, that

The best
of swimmers
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chance to
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selves.

they are perishing, and die with cold, when the brave man at the same time may be sweating with struggling manfully in the discharge of his duty; as in the late melancholy loss of the Halfswell Indianaman, in the King's channel. Therefore our marine laws which is much wanted, should allow the officers to force their crew by all possible means to their duty when great danger appears, without being afraid of the law, which should only make the defaulters suffer according to the damage, or loss of lives or property, their disobedience to command may occasion.

To try
to clear
the shore
by carry-
ing sail,
and to
box-haul
when the
ship refus-
es stays.

ON A SHIP BEING NEAR A DANGEROUS LEE SHORE.

TO keep a ship off from a dangerous lee shore; carrying such sail as will give her good way through the water upon a wind, as long as she will carry it, is certainly the best method to try what can be done; also reducing all top hamper, that holds wind, as much as possible; for if the shore proves so deep, or the bottom so rocky, as not to afford safe anchorage, then safety may depend entirely on carrying sail. And suppose the ship is found embay'd, so that she will not clear the shore on one tack, and that the waves run so high that the ship will not stay, yet she may be box-hauled, and warded, to lose very little ground, as mentioned page 79, on box-hauling; and in the instance of turning to windward out of Mount's Bay, mentioned page 161, with the method we used in box-hauling represented in fig. 1, 2, plate the 7th. Therefore despair should not take place, but an example of spirit and resolution shewn by the officers, after having consulted together, and the people plainly told what is resolved upon, and that there is no other chance left to save the ship and their lives, but to carry all the sail possible, to work the ship in the most perfect manner; and when she refuses stays, to box-haul her, as before fully described.

SUPPOSE in this situation it is found, that the ship will not clear the shore on either tack, and after the utmost endeavours she is perceived to lose ground; but as there is no anchorage, there is no other means but to continue turning to the last, as the wind may abate, or it may vary or change in your favour, which was the case with an intimate friend of mine, who kept turning, though he fell to leeward instead of gaining to windward, till they thought it would be the last tack they could possibly make before they must be

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On SHIPS being forced upon a dangerous LEE SHORE.

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be on shore, when providentially the wind changed, and came right off the shore all at once, which saved both the ship and their lives from immediate destruction.

BUT when it happens, that there is clear anchoring ground at a good distance from the shore, and sailing proves ineffectual to keep clear of it, then the chief dependance must be upon the ground tackle applied to the best advantage; and it is in common reckoned a great disgrace to let a ship go on shore with any ground tackle left on board that might have been usefully applied.

SUPPOSE then the ship to be properly prepared, and to have let go a catch anchor, and towline bent like a buoy rope to the crown of the stream anchor, and the inner end of the stream cable bent to the crown of the sheet or best bower anchor with as long scope of cable as possibly can be contrived, to make the ship ride safe and easy, as is particularly mentioned and recommended in page 94: Where it is known, or found, by sounding with the lead armed with tallow, that the ground is foul, then no more cable should be veered out than necessity requires to bring the ship up, to ride with as short a scope as possible, because the cable is liable to be chased or cut in two by the rocks; if that happens, there is then the more room a stern, and a better chance, for a second or third anchor; trying, to the last moment, all possible means to keep the ship from the shore.

WHERE the water is so deep that the anchoring ground lies but a little more than a cable's length from the shore, then all the anchors should be let go, as fully described to answer this purpose, page 98. And when the necessity of the situation requires it, no hesitation should be made, immediately to cut away all the masts, except the fore-mast and the bow-sprit; (the fore-top-mast-stay-sail being made to hoist to the fore-mast head,) which will not only make the ship ride with less strain upon the anchors and cables, but, if they give way, she will be the better prepared, when necessity requires it to be done, as the last refuge, to run and lay the ship on shore to the best advantage, in order to save all the lives and property that is possible to be saved, rather than let the ship founder, or strike the ground at an anchor, by the tide falling, &c. which affords no chance of saving either lives or property. Therefore all possible endeavours should be used, and attempts made to try every thing that can be said or done, that may prove serviceable on this melancholy occasion.

To endeavour
to ride out
a storm on
a lee shore.

To cut
away the
masts if
necessity
requires.

THIS

THIS often has been and may be the fate of many ships in spite of the utmost powers of men; and when a ship's situation is such, that to all appearance it cannot be avoided, then the utmost endeavours should be used, and no possible means left untried, that may any way contribute to be servicable on this last and most important occasion, to save all the lives and property that is possible; whether successful or not, it deserves the highest encomiums, as being the greatest proof of true courage and good conduct.

BUT ships situations, circumstances, times, and places, are so different and various, that to give advice on this dreadful occasion is difficult: yet, at all hazard, every thing likely should be said and done. For it is well known, from reason as well as experience, that to let a ship drive at random broadside to, where the tide is flowing upon a moderate rising shore, with her main-mast standing, when she comes to strike hard upon the ground, by the waves running high, she will soon overset on her broadside, and cause the hatches to blow off; then the waves will break in at the hatchways and compress the confined air within her, so as to add the power of blowing to that of beating the ship to pieces, which must afford little or no chance to save lives, or property which is liable to be destroyed or spoiled by the waves, and therefore likely to occasion a fatal and total loss.

THESE reasons, I hope, will be thought sufficient to prove the necessity of endeavouring to point out better management; for it should be considered, that a ship going on shore at these times in a tide's way, upon a flood, will continue beating as long as the tide flows, and until it falls; and if she lies broadside to the waves, they will have about three times more power on her than when laid end on to them; and the mainmast, standing in the main body of the ship, occasions her to overset at such times: and it is well known, that a ship will bear but little beating upon her broadside in proportion to what she will bear upon her bottom.

THEREFORE the best conduct, on this occasion, is to use all possible means to keep the ship from going on such a shore as this till after high water; and the main and mizen-mast being first cut away, then to run right before the wind and waves, with all the head way and sails that possibly can be set, end on upon the shore, to make the ship free herself the more, and to run the higher and faster upon the ground, so that by the advantage of the tide falling, she may soon be set so fast as to be out of the power of the waves

The best
manage-
ment on
a gradual
rising
shore in a
tide way.

waves to hurt her much. By this management, in my opinion, not only all the lives, but the ship and cargo may be often saved, which would be all lost by letting her go at random with a flowing tide.

NOTWITHSTANDING a ship may be thus successfully run and set fast upon a shore, with little damage to her hull, and no danger to be apprehended till towards high water the next tide, if the storm continues so long; yet people too often let their fears overcome their reason, and being in too great a hurry to quit the ship, and attempting to get on shore through the waves, may often lose their lives and the boats they go in; when if they would consider and stay with patience till the tide falls low enough, they may get safe on shore with little or no risk; and where the tide rises and falls a great deal, the ship may come quite a-dry at low water; which time must be allowed to be the safest and best to land, whether the ship dries or not; for the water is then smoothest and there will be the less way to go in it: therefore, if possible, the people should be restrained from quitting the ship with the boats, till towards low water; and when got safe on shore, it may be absolutely necessary, to preserve the boats, to haul them out of harm's way, above high water mark, out of the reach of the waves, where they may be turned bottom up, and made a place of shelter when there is no other to be had, and be still ready, to go to the ship, if the weather permits, and occasion requires.

ON this, as well as on many other useful occasions, the best and easiest method to haul a boat up and down over a long gradual rising sand, or strand, deserves notice. Instead of the common method of laying oars across, and hauling the boat upright over them upon the keel, end on, I would recommend, from experience, first to lay the boat broadside to the shore, the way she is designed to be hauled, and heeling her off, so as to put the blade of a single oar under her keel a-midships, and lay all the other oars length way, the blade of one to the loom of the other; then the boats crew divided equally on each side of the oars, take hold of the gunnel, heel her bilge upon the first oar, keeping her upon a poise, and run her along with great ease, the whole length of the oars at a time; and if a little sea-tang can be got to put under the bilge of the boat, it will make her slide with more ease along the oars, which are to be shifted forward when the boat is on the loom of the last oar, &c.

On hard
rocks,
steep to
under
water, and
high up-
right cliffs
above
water.

DIFFERENT shores require different management on this desperate occasion. And where the shore is nothing but hard rocks, steep to, under water, and high lofty upright cliffs above water, which are impossible to be climbed up; in this situation, no sail can be of any service, therefore all the masts should be cut away, and safety then depends entirely on the ground tackle being used to the best advantage; and if the ship drives till she comes near the high cliffs, it is well known they make both the wind and waves to rebound from them to some distance, where, if the ground tackle happens to hold any thing, it may give the ship a chance to ride there; and as this is the only chance against a fatal and total loss, it ought to be tried in the best manner it is possible.

On a gen-
tle rising
shore,
when the
waves are
not so
violent.

SHIPS drove broadside on a gradual rising shore, when the waves are not so violent as to bulge them directly, may find great advantage from lightening them abaft, or trimming them so much by the head with their goods, or ballast, as to make them swing end on, with their heads to the sea, which is certainly the best position a ship can be laid in, not only to bear the force of the waves with the least damage while the gale lasts, but to heave the ship off after the gale ceases. When water is wanting for this or other porposes of great necessity, in proportion as a ship can be made to heel, it lessens her draft of water.

On Saving Lives from a SHIP lost on a LEE-SHORE.

TO be any way aiding and assisting to save the lives of people from ships that are forced, or lost, upon a lee shore, must be allowed to be one of the highest acts of humanity and charity that mankind is capable of performing, and deserves the highest praise and the most grateful acknowledgements that are possible to be given. And to offer to destroy or distress the distressed in this lamentable situation, must be deemed the highest act of villainy, and deserves the severest punishments which our laws very justly inflict.

TIME circumstances, and situations, are so various, that it is very difficult to write what may be to the purpose on this most melancholy occasion. And another defect I must own, (for which I have great reason to be thankful to Providence) never having been ship-wrecked, I cannot pretend to write from experience; yet,

yet, under all these disadvantages, as I think it is absolutely necessary that it should be attempted by some body, I venture (sailor like) to do my best.

SUCCESS in many situations may depend greatly on assistance from people on shore; but as that is uncertain, and cannot be expected in the night, or in desert places, therefore the utmost endeavours should be used to contrive and try what can be done on board a ship, that may be supposed to be bulged or broke, so much upon the ground as to be past all recovery. And when a current or tide runs so strong between the wreck and the shore, as prevents booms, masts, or yards, &c. with ropes made fast to them, from being veered on shore, and even the patent cork lines that ships have on board, contrived for the purpose of veering to people on the shore, in order to get ropes passed to make hauling lines, or travellers, from the ship to the shore, as necessity required, to save the people, have been rendered ineffectual by the current or tide.

I was told by an officer of the LITCHFIELD, (a 50 gun ship lost on the coast of South *Barbary*,) that all their endeavours proved ineffectual to get a rope on shore, from the strength of the current. And an acquaintance of mine, cast on a lee shore in our neighbourhood, could not get a line on shore, where there were many people ready, endeavouring to help them; the recoil of the waves always washed the buoys off again, out of the power or possibility of the people on shore to reach them with safety.

THEREFORE, in order to endeavour to mend the defects of these contrivances,^{Experiments recommended to be tried for this noble purpose.} for this most noble purpose, I take the liberty to propose to those in power, to have experiments tried on board his Majesty's ships lying in ordinary. First, whether it is not practicable to make a *flying storm kite* on board a ship wrecked upon a lee shore, that may, by the force of the wind be made to carry an iron-creeper or grappling, made fast to the end of a rope, from the wreck to the shore; by which, access may be got to the shore, when prevented by the tide, current, or returning waves; as above mentioned.

I would propose these kites to be such as may be easily and readily made on board any wrecked vessel, and to consist only of two slips of thin deal board, about three inches broad, the long piece to be 7, 8 or 9 feet long according to the weight of the creeper, grappling, or boat's anchor, and the rope designed to be sent on shore; and the cross piece about half the length of the

long piece, to be nailed about a third from the top that forms the kite, to be spanned with logg or lead line from the four ends of the boards, and covered with a piece of light sail, and flung from the four ends of the boards, and strengthened with a span in the middle to the lower part of the croſs board, where the kite rope is to be seized, and at the lower end of the kite, 2, 3 or 4 fathoms, from the end of the kite rope that is to be bent to a grapping, creeper, or boat's anchor, to answer the purpose of the kite's tail, to balance it's flying the same as boys common kites are with twine in moderate winds, to be flown from the wreck above the shore. Then it may be asked how the kite may be made to fall so low that the anchor, &c. may take hold of the ground, if necessity requires this immediately to be done, and have still a scope of the kite rope on board, the experiment might be tried by letting kite rope run loose for a time, the weight of the rope and anchor, &c. if they would not make it immediately fall upon the ground.

BUT if this cannot be done, what is called messengers may be made and sent up by the force of the wind, the first I would propose to be made of three boards eight or nine feet long nailed together, to form a triangle and covered with a piece of sail, and a hole made through the wood in the upper corner for the kite rope to be reeved through, and a line according to the height of the kite rope above the ground to be made fast to the middle of the lower board, that if any inhabitants appear they may haul it down, and fix the anchor fast in the ground that a traveller may be made by it. And if the downhaul line be long enough for the end to be kept on board, a larger rope may be hauled on shore by the inhabitants, and fixed so, that a strong traveller may be made that not only lives but property may be saved by it.

SINCE publishing these hints, I saw an account of a letter being sent on shore from one of our ships of war, (when they durſt not venture with their boats to make their wants known) by putting a letter in a bottle tied to a kite's tail as here mentioned. The end of the kite's tail made fast to a wooden buoy that floated on the sea, that kept the kite in such an elevation, that the bottle could be readily received by the people on shore. And it may be easily perceived how an anſwer might be returned by the ſame means, if required, by hauling the kite back to the ship.

THE next experiment, for this purpose, I would propose to be tried, is, how far it is practicable to shoot a grapping with a rope bent

bent to it, lashed along the outer end of a handspike, &c. made round just to fit the bore of a great gun, and long enough to reach from the ring of the grapping close to the wad next the powder, with the gun elevated to its highest range, in order to get a rope from the wreck to the shore. And all the ropes that may be necessary on this occasion, should be with long splices to answer this purpose best.

LET it now be supposed, that a rope is got from the wreck to the shore, and secured as well as possible till some body can be got on shore by it to secure it better. To do this, I would propose to sling, in a light but secure manner, to two single blocks, one at each end, some of these things that can be easily come at on board the wreck, such as a cot, a scuttle cask, a chest without its lid, a main hatch, or a cabin table the lower side up, &c. that a man or two, as the situation and circumstances may admit and require, may be secured in or upon this machine; then reeve the shore rope through the machine blocks, and to that part of the wreck where it may lead and be hauled tight to the greatest advantage, to support the machine, running or travelling upon it from the wreck to the shore, in the surest and best manner possible; and if the wreck has any lower masts standing, the shore rope leading over the mast head, would most likely answer the purpose best, and the top afford a convenient place to get fixed in, and go from, with the machine to the shore. And a hogshead, puncheon, or a butt, in my opinion, might be skuttled on each side of the bung, for a machine; so that two men might stand facing each other, to great advantage, to haul it on shore, if the situation required it; or any other thing that the shore rope and tackle may be thought strong enough to bear.

BUT the facility or difficulty attending the execution of these proposals, are in proportion to the distance and height of the shore from the wreck; if the shore is low, and near the wreck, the shore rope may be made to lead the machine upon it with an easy descent, from the wreck to the shore, with a man or two in it, without much strain either to the rope or grapping on shore. When this is likely to be the case, a line should be made fast to the machine, to haul it to the wreck again; by which means it may happen that a shipwrecked crew may soon get on shore, with ease and safety.

BUT when the shore happens to be at a great distance, and much higher than any part of the wreck, this must naturally increase the strain on the shore rope and grapping, &c. that holds

it, and to the man or men who are to haul the machine on by it. Therefore, to endeavour to ease this strain, I would propose, as it appears to me practicable, to contrive and fix a sail to the machine, such as a hammock or two that has been ready wrought at each end, a tarpawling, or a piece of a sail for the purpose, that may be soon bent and stitched with a needle and twine to light pieces of wood; one to be as a yard stopped to the head of an upright piece or two, that may be stopped or lashed to the after end of the machine as masts, ten or eight foot high above it, next the ship, and the foot hauled down to the fore part of the machine next the shore; this sail fit to stand in this slanting direction upon the machine that is to run right before the wind in a storm, will certainly help greatly to lift and lessen the strain of the machine upon the shore rope, and force it forward with great power towards the shore. And if, by any such means as these, a man or two can be got on shore safe, they may secure things to the best advantage; and by hauling lines, may be the means of getting all the rest of the people on shore, before the wreck is beat to pieces by the waves.

BUT it may be said, that the first adventurers in these machines run a great risk; which must be allowed; but desperate situations require desperate proceeding; when delays are dangerous, if this is the only method that appears to give chance to save life, the first adventures stand the best chance if they succeed in getting on shore safe, when every minute the wreck may be liable to be beat to pieces, and all left on board most likely to suffer.

Now let it be supposed that their is neither tide nor current to hinder any floating things being drove on shore from the wreck, by the force of the wind and waves. Then a towline, or other suitable rope, with a hauling line, &c. may be made fast about the middle of a spar, mast, or yard, &c. and veered away on shore, as far as it will go; and if it happens to be an uneven rocky shore, it may chance to fix itself fast among the rocks, by which I have heard a ship's crew got on shore, when they had almost given themselves up for lost. But if it is a sandy or gravelly shore, then no such chance can be expected; it will then require some people on shore to haul it up, and put it under the sand or gravel, its broadside to the wreck, (as described page 107, on mooring ships) to make it bear the strain that is necessary for the rope to be tight enough for the machine, as abovementioned, to travel upon from the wreck to the shore.

Now

Now let it be supposed, that a set of good people appear upon the shore, for the noble purpose of doing all in their power, to save the lives of those distressed people on board wrecks. To succeed therein, it is absolutely necessary that the people on shore should be made to understand something of the designed methods of proceeding. Therefore the best and most approved methods that experiments may produce, should be recommended and described in prints, for the purpose of being distributed amongst our ships, and amongst the inhabitants along our sea coasts, to be made as public as possible, and rewards of a guinea, certain, should be allowed to the poor people on shore, for every human life saved by them, from wrecks, and vessels forced on shore. *Liverpool* leads the way for this noble purpose; and in proportion to the danger and trouble, they are to be rewarded with more than a guinea, as it is thought by a committee that they deserve; which encouragement may likewise be the means of saving their own lives from the just laws of our country, by preventing their cruelty, for the sake of plunder, on these occasions; and might encourage them to observe and join heartily in whatever methods they perceive the people on board the wreck take to save themselves, and to help them in it, by securing the shore rope, or using the hauling line to haul the machine on shore, if it is high above the wreck, or made fast to a raft, as the circumstances and situation may require. And if ever the time come to have such prints on board ships for this purpose; such as that patent Print invented by Mr. John Winn, of Great Yarmouth. To which I think might be added, that instead of anchors, which are not always to be had, any wood, or bulky matter, put under the sand, with their broadest parts towards the wreck, will even hold more than anchors on such occasions. And I could wish that such another plate for a wreck was represented, where there is neither sand nor strand to come adry, and only high, steep, inaccessible rocky cliffs, with some such methods as I have endeavoured to describe, page 268. And they might by some means be put into a bottle, and sent on shore to instruct the inhabitants, if any appeared. One of them should be rolled up and put into a bottle, and sent from the wreck to the people on shore, by some such method as abovementioned; or by throwing the bottle, well cork'd, in the sea, to make them understand the designed method of proceeding: which may be the means of saving many valuable lives, as well passengers as ships crews, whose lives are undoubtedly of much more importance than

Certain
rewards
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mended.

than ships. Ships may be renewed, but they are of little purpose without good crews to navigate them; and the difficulty we now meet with, in manning both ships of war and merchant's ships, should teach us to use every possible method to preserve the lives of our brave seamen, those supporters of our glory, power, wealth, and consequence as a nation;—they dare the raging tempest cheerfully, and the dreadful slaughter from thundering cannon does not dismay them; therefore, how pleasing must the thought and reflection be, to all who contribute to help and save them.

On preserving Boats from Foundering when Ships Founder.

IN January, 1786, in the *Liverpool news-papers*, I met with what I think an excellent method for this purpose, related as an experienced fact, which I thought, well deserved to be made further public, to recommend the beneficial practice to save lives on such dreadful occasions. It was related as follows.

THE *BASIL*, in her passage from the *West-Indies*, took up ten men in a small boat, 12 feet long, which was preserved from foundering, after their vessel had founder'd, by having a rope fast to a log of wood, as they called it, and tied to the boat's bow, which kept her to drive end on with the head to the waves, and broke their violence so much as to preserve her from filling with water, when one half of them was obliged to lie down in the bottom of the boat, to prevent her being top-heavy.

I READ this account with great pleasure, but could form no idea, how a common log of wood could answer this good purpose. I therefore went to be better informed of particulars from the Captain and Chief mate of the *BASIL*, from whom I learned, that these people belonging to a schooner, bound from *Ermudas* to the *West-Indies*; that it was after a hard gale of wind when they met with the boat, and took them on board. And that the log of wood, as it was called, they drove by, was their fore square sail yard, spanned with a rope to each yard arm, and a rope about 10 or 12 fathoms bent to the middle of the span to the boat's bow, to drive by as above related.

I ASKED them if the people had told them what distance they drove from the drift boom (which I shall now call it) in the time of the storm: they said, no. And whether this method was their own

own invention, according to the proverb that necessity is the mother of invention, or from a practice known before. The Captain said, the Mate of the schooner told him they had been saved so, in a boat once before, by driving to leeward of a mast (as he called it) in a hurricane in the *West-Indies*, which I heard further confirmed by inquiry amongst our seafaring gentlemen who had been factors in the *West-Indies*. I met with one that said he had heard of such a practice in hurricane times. It therefore deserves our endeavours to account for it from natural causes and effects.

IN affairs of this kind we must be allowed to compare small things with great; and from the practice of all common water carriers in open vessels, it may be observed how experience has taught them always to have a dish, or some piece of wood swimming on the water, to prevent its waving over the top of the vessel. And it is well known to all experienced seafaring men, with what ease and safety an open boat will rise and fall in high solid waves, and especially when kept end on to them, in comparison to what they will do in broken waves, where they are very liable to be brought broad side to them, and when the broken water naturally soon fills them.

THEREFORE the cause which makes waves to break, is a material point in treating this subject philosophically. And it may be observed, that waves never break till their tops are forced forward by their great velocity beyond the perpendicular of their base; then that solid water falls down forward, and incloses and compresses a quantity of air, which by the power of its elasticity blows this fore part of the waves to pieces, forwards and upwards, in an oblique direction, and makes it appear like froth. They then have no buoyant power to lift a boat; but when they are high, they fill and sink her. And they break more in shoal water than in deep, in proportion as their bottoms or bases are more obstructed in their velocity by the ground than their tops; hence in very shoal water they are continually breaking, so that they make nothing but what is called broken water, by which shoals may be seen and known at a great distance in clear weather.

If we endeavour to account for the wonderful effect of so small and simple a machine to preserve such a small boat, deeply laden as she must be with ten men, from being filled with water in such a storm; in my opinion, it is owing to the boat driving end on by the drift boom, that keeps it always swimming on the surface broadside to the wind, and the waves that are running towards it

within the length of the drift boom, must certainly obstruct the velocity of the upper part of these waves, so as to lesson their increase in height, and prevent the top from running beyond the perpendicular of the base or bottom of these waves, that occasions their breaking, as has been described, but spend themselves without breaking. These reasons, I hope, will be thought sufficient to recommend this method to be tried and brought into practice on such dreadful occasions. And I cannot help thinking that the same method shoud be tried, when under the dreadful necessity of saving lives by boats landing on a lee shore in a storm where broken waves run high. The only difference I would recommend in the management, is to proceed with the boats stern to the drift boom, and her head to the shore, to be ready to row and steer for the best apparent landing place; and if it is a long flat shore, as soon as the boat strikes the ground, cut or slip the drift boom rope, that it may not haul the boat off the shore again by the back sweep of the waves.

To make a drift boom, no doubt but any mast, boom, or yard, will answer the purpose; but of course the larger and longer, the better. I could not learn from these people any rule for slinging it, &c. But what I would recommend is, the bight of the span, after being well made fast to each end, to be full twice as long as the boom, and the boat rope to be bent exactly in the middle of the bight of the span, which need not, in my opinion, be above ten fathom long; for I think the boat's driving either by the head or stern, should be within three or four fathom to the bend of the span, to find shelter from the drift boom in a storm. And when this misfortune happens far from land, and the storm ceases, in moderate weather the drift boom may be towed end on to the boat's stern, that they may either row or sail towards land; as, by the account, this small boat had two oars, for masts, and two blankets set upon them for sails, and was steering for *Bermudas*, when they were fortunately taken up and carried there; what little bread and water they had, being almost expended.

To prevent Thirst on these Miserable Occasions in a Warm Climate.

AN D as the want of fresh water often adds to the misery and destruction of people in these dreadful situations, I here relate a simple method to prevent thirst, as taken by Mr. *John Kennedy*,

Kennedy, a commander in the *African* trade, from whom I had it, who was put to the necessity with his ship's crew, to run along way towards the *Bay of Honduras*, to save their lives, without fresh water. The method they took by his recommendation was this; having some blankets in the boat, in the day time when the sun was hot, they, by turns dipped the blankets in the salt water, and wrapped them close to the trunk of their naked bodies, which have such wonderful powers and properties given them, as by absorption, or suction as seamen commonly call it, to attract or suck in through the pores of the skin, the finer particles of the fresh water from the salt that is mixed with it, which he reckoned not only saved them from thirst but from death. And at his return home, he gave a report in person to the most famous Physicians in *London*, who received him with polite attention, and thanks for this new discovery, by which he and his people where saved. But it may be doubted whether this method could be used in temperate or cold climates, and whether in very cold weather the remedy might not be worse than the disease: but then in cold weather thirst is not so prevalent as in warm climates.

Dr. *Franklin*, in his 52d letter on philosophical subjects, from the same reasoning, imagines, (and he says it will probably be consider'd as a whim of his,) "that the thirst of a crew at sea, in want of fresh water, may be relieved, either by their sitting an hour or two in a day, in bathing tubs made of their empty water casks, filled with sea water; or by keeping their clothes wet with it."-- If I recollect right, this method was practised by Commodore *Byron*, with success, and is related in his Narrative.

ON THE HEALTH AND DISEASES OF SEAMEN.

INTEREST as well as humanity, demands all that can be said to any purpose on this important subject, because it must be always allowed, that success depends on the health and spirits of the ship's crew, in their different stations, to do the duty with dexterity and bravery, which difficult, dangerous and trying occasions often require: and it is certainly much better to endeavour to prevent than to cure those diseases seamen are most commonly subject to, from the hardships they are obliged to go through in doing their duty with reputation, the effects of which I have learned from

my own feelings, and observations on others who have suffered by them. This induces me to endeavour to relate, what I have seen and experienced myself, and to make a few remarks which I think may be of some service to my brother seamen.

ON this occasion I do not pretend to write as a doctor, but as a sailor who has tried how far he was capable by use to accustom himself to hardships, which it is commonly expected the hardy seaman should be able to bear without losing his health.

ON WEARING AND SLEEPING IN WET CLOATHS.

I TRIED the experiment of wearing and sleeping in wet cloaths, when I had dry ones to put on, till I got the cramp by it. I have been a sufferer by refusing to put on sufficient cloaths to guard against the effect of a dry cold wind, even in the fine climate in the *Mediterranean*, off the south of *France*, where our weak and sickly gentry go to recover their health. I was mate of a bomb's tender in *Hieres Bay*, with our great fleet under *Matthews* and *Leftock*. In the fall of the year a fresh northerly wind blew right off the shore, which I felt so piercing cold, as to demand putting on another jacket, and to wear two instead of one, which I thought it was too early in the season to be obliged to submit to. In consequence of refusing to comply with this demand of nature, I was soon taken with a griping which ended in a violent fever, from which I very narrowly escaped with life.

ON THE BLOODY FLUX.

TWICE I have had this disease; once by being long wet in a deep loaded ship in a winter's passage from *Jamaica*: The other time by sleeping on the bare ground, in that warm country the *Bay of Honduras*. The quick and easy cure I met with in the height of this disease, I think deserves mentioning. When I was obliged to have a painful motion every quarter of an hour, and durst not expose myself to the least air of wind, I was told of ships that were coming into the bay, without first sending in their boats, as usual, to make known who they were; and being then by turn

(as

(as was customary) deputed commodore, I gave orders to fire at them; which they not paying regard to, but continuing to run in, it alarmed and roused me to action, and I was four hours afterwards without going to stool; and then I had a favourable one, and soon got well. So that we may sometimes be roused into action greatly to our advantage.

ON THE SEA SCURVY.

I HAD the experience of this destructive disease for about three months in a passage to the *East-Indies*, in the year 1738-9, when for the advantage of private trade, as I was told afterwards by the ship's husband,) we sailed with ten tuns of beer and fresh water short of the usual quantity allowed to be carried, and yet the ship so deep laden, that in our passage to the Downs, she shipped so much water that filled her deep waist, and frightened and occasioned the seamen to protest and refuse to proceed on the voyage without the ship's being lightened. But a ship of war in the Downs settled the affair by taking, and changing for other men, some of the principal promoters of the protest, which made the others comply to proceed on the voyage.

We were seven months on our outward bound passage, without touching any where for refreshment, till we got to *Pullicat*, a Dutch factory near *Madras*, where we were bound, and were five months at shore allowance of water, which, with the very salt beef that had remained from the last voyage (consequently above three years salted) being the first used in this, was the occasion of the scurvy coming the sooner, and being more severe, amongst us.

This being my first voyage in this trade, and only a forecastle man; as I was advised, I laid in a little sea store, of what was thought necessary, nourishing things for these long passages; but I happened to meet with a messmate of a living and trading turn, who in his last voyage to *China*, had made great profits from a small adventure; and as we were bound from *Madras* to *China*, he advised me to sell my little store of brandy, sugar, sage for tea, &c. when they became a good price, and join him in partnership in adventures; which I did; thinking my youth, health, and strength of constitution, would enable me to live upon the ship's salt provision as I had done in common merchant's ships before: but

I found myself much mistaken ; for after being about four months in our passage from the Downs, after eating a hearty breakfast of salt beef, I found myself taken with a pain under my left breast, where I had formerly received a dangerous blow. From this time the sea scurvy increased upon me, as it had done upon many others, a good while before me ; and I observed, that they soon took to their hammocks below, and became black in their armpits and hams, their limbs being stiff and swelled, with red specks, and soon died ; I therefore kept exercising in my duty, and went aloft as long as possible, and till forbidden by the officers, who found it troublesome to get me down with safety, as I frequently lost the use of my hands and feet, for a time, in the same manner as I had done when I received the above mentioned blow. I then endeavoured to be useful below, and steered the ship, till I could not climb by the notches of the stantion at the fore hatchway, upon deck ; which I told the Captain ; who then ordered the carpenter to make a ladder, that answered the purpose for the sick who were able to get upon deck for the benefit of exercise, and pure air ; as that below being much tainted by so many sick. I thus struggled with the disease, 'till it increased so that my armpits and hams grew black, but did not swell, and I pined away to a weak, helpless condition ; with my teeth all loose, and my upper and lower gums swelled and clotted together like a jelly, and they bled to that degree, that I was obliged to lie with my mouth hanging over the side of my hammock, to let the blood run out, and to keep it from clotting so as to choak me ; till after a seven months passage we arrived in *Pullicat Read* : from whence we got fresh provisions, and sent for men to carry the ship to *Madras* ; where, what remained of the sick, were got on shore to sick quarters ; and where, with fresh provisions and fomentations of herbs, I got well, and returned on board in eighteen days ; where I found a stout gang of the country seamen, called *Lakers*, to work the ship in her voyage to *China*, and home.

This attack of this destructive disease, appeared evidently to proceed from eating two much salt meat, and a short allowance of water, &c. I therefore formed a resolution, as much as possible to endeavour to avoid it in future, by eating no more salt meat than just to give a small relish to my bread, or rice instead of bread, which we had for eleven months in the voyage. And, at all possible opportunities, to get a little *Tea* made for breakfast, instead of salt meat (which increased thirst the whole day) and by that

that means to save of the short allowance of water. When we came to *Caston* in *China*, I there saw my adopted method of living, in real, general practice; where they cook their animal food, highly seasoned, in small morsels and only take one of them at once, into the mouth, which is nearly filled with boiled rice) and drink tea afterwards, without sugar, to digest it.

It has been my custom, ever since, to drink tea twice a day, when I could get it. And to let lovers of tea know I have had it made in a very nice manner, on board a ship, where there were no tea utensils; I will inform them that it was by putting the tea into a quart bottle, filled with fresh water, corked up, and boiled in the ship's kettle along with the salt beef. When it came out it was as fine drawn tea, as ever I saw. It may afterwards be sweetened, at pleasure, in the same bottle; and, with something to eat, may be given to sick people in bed, to bite and sup, in stormy weather, when tea pots, cups and saucers, and other means cannot be used with safety. No doubt coffee may occasionally be made and used at sea in the same way.

WITH the above proposed method of living, I kept clear of the scurvy during the rest of the voyage, when many of my shipmates died with it; and except these disorders here mentioned, I have ever since, through providence, enjoyed an uncommon share of health, to my seventy fifth year. In this voyage we had instances to prove, that a sufficient allowance of fresh water, and a little fresh meat, prevented the scurvy, and preserved those alive, that had it longest. Our butcher and poulterer, by having water for the Captain's live stock, and the offal from them, I suppose kept them free from it. The first man that took it, was a reduced ship master, that happened to be the Captain's townsmen, who sent him a plate of fresh meat every day from his table, which prevented the disease from increasing upon him for above four months, and which certainly saved his life.

BUT to preserve the health and lives of seamen through all the different climates and extremes of heat and cold, we must have recourse to the immortal character of Captain Cook, mentioned page 6; who explored the world and fixed its geography in a much more perfect manner than was ever done before; and preserved the health and lives of his ships crews in so extraordinary a manner for so long a time in unexplored seas, both North and South, as far as the ice would admit, as hardly could be equalled in the same number of persons in any part of the world: And who may be said

said to have died gallantly on his duty, by being too anxious to prevent the effusion of human blood.

ON THE MEANS OF RECOVERING DROWNED PERSONS.

IN the year 1773, an institution took place in *Liverpool* for this laudable purpose: and the following are the printed directions which are distributed and fixed in and about such places as where the accident is most likely to occur.

R U L E S.

" THE drowned body is to be taken as expeditiously as possible into the first convenient place at hand; and in carrying it, care must be taken not to let it be bruised, nor hauled roughly, nor carried with the head hanging downwards, nor rolled, nor lifted up by the heels, if it can be avoided, as such usage often destroys the little life remaining. It should be carried carefully, in a natural, easy, posture, (the head raised a little,) on a board, window-shutter, or ladder between two persons."

" II. *In the house*, the body should be immediately wiped dry, and placed in a moderate degree of heat, in a warm bed, blanket or jacket. Bottles of hot water, or hot bricks, wrapped in cloths, should be put to the sides, the bottoms of the feet, under the hands and arm-pits; warm clothes put about the head; and a warming-pan, not too hot, should be rubbed over the body, and particularly along the back. Warmth may also sometimes be procured, by putting the body into moderately-warm ashes, grains, sand, steam, or water, if at hand; or in bed by the side of a healthy person; or in the skin of a beast newly killed. The windows and doors should be left open, and as few persons as may be, remain in the room; since pure air is of the greatest necessity."

" III. *Warmth being applied thus*, as soon as possible, the next things to be done are: first, to blow with force into the lungs, by applying the mouth to that of the unfortunate person, closing his nostrils with one hand, and gently pressing the chest with the other, so as to imitate the strong breathing of a healthy man. For the sake of cleanliness, a cloth may be put over the mouth whilst this is done: second, At the same time, the smoke of tobacco should be thrown up into the bowels by means of a pipe, sheath, bellows, fumigator,

fumigator, or other fit instrument, and the belly stroked and pressed gently upwards: third, The head, belly, breast, sides, back and arms, should be well rubbed with a coarse cloth or flannel (or a flesh brush) sprinkled with brandy, rum, gin, hartshorn, or with fine dry salt; and hartshorn must be put up the nostrils, and rubbed upon the temples frequently.—The body should now and then be well shaken, and its position altered. The mouth should also be cleansed from slime, by a brush or feather."

" III. When there are any signs of returning life, such as sighing, gasping, twitching, beating of the heart, or the return of the natural colour or warmth, a vein may then be opened in the arm or neck, but not an artery; the taking away much blood doing great hurt. Nor is bleeding in all cases necessary or proper, unless, after signs of life appear, a visible oppression requires it.—With a feather, tickle the throat to cause vomiting; and the nostrils, and give snuff, to provoke sneezing. Give a tea spoonful of warm water now and then, to try if the power of swallowing be returned: when it is, give a meat spoonful of warm wine, or water with a little brandy or spirit of hartshorn, but not before, least the liquor should get into the lungs, and suffocate.—All these methods should be continued with vigour, two hours, or more, even though no signs of life appear, or till it be gradually restored; a speedy recovery being very seldom to be expected.—The frozen must be first rubbed with snow, or spunged with cold water, till unfrozen, and then gradually brought into warmth, and assisted with other means."

I HAVE been induced to insert the above, as by diligently pursuing these rules, many valuable lives have been, and I make no doubt but many more will be saved, to the great benefit of themselves, their families and the public.

THOSE who occupy their business in great waters are frequently liable to accidents of this sort, and surely none of them would be slack in their endeavours to restore a brother seaman to life. Let every one consider how soon, and how easily, it may be his own case; how dreadful it would be for him to be suddenly snatched away, in the midst of a careless, and thoughtless, if not a vicious life;—and what a blessing he should consider it is, by any means, that life should be restored to him, which he might afterwards employ in the support and maintainance of a family whose bread depended upon his labour, and in a conduct so decent and regular, as might lead him to hope for the future mercy of Heaven.

I ONCE had the pleasure of taking up one of my seamen from under water, and to all appearance drowned; but by our exertions recovered him; and the first words he was able to speak (perceiving me busy about him) were "my dear Captain pray for me." To which I replied, that as he was now in a fair way of recovery, I hoped he would be able to pray for himself, and be thankful to providence for his narrow escape.

THE public is much indebted to my late worthy and benevolent friend Dr. *Houlston*, for the active part he took in promoting this Institution. And I take this opportunity of acknowledging the obligation which I have been under to him for his assistance, while his health permitted, in the revisal of this treatise.

ON A MARITIME ACADEMY FOR LIVERPOOL.

A MARINE Society for the relief of distressed masters of ships, and their families, has lately been happily established here, and is now, to all appearance in a prosperous state. Much, however, still remains to be done for the encouragement of that useful body of men, who devote themselves to the sea service. A Maritime Academy, or School, for the proper education of those who make choice of this way of life, would certainly prove of great public utility, and conduce in a very important degree to the improvement and security of our Marine.

LIVERPOOL has not at present any establishment of this kind, though the nature of the port renders it particularly wanted, and especially for the training of Pilots. A moment's reflection on the important charge deposited in the hands of the people of this profession, will put beyond a single doubt, the great advantages which would certainly arise from the adoption of such a measure. The neighbouring nations, our competitors in arts and arms, and particularly that kingdom which stands forth the most dangerous rival in our manufactures, commerce, and naval power, have Maritime Academies in all their principal sea ports, to train their youth designed for sea officers, in the theory of such arts and sciences as are deemed a proper foundation for their intended profession. Self defence then requires us to aim at equal perfection, by using equal means for its attainment. When boys have acquired such a degree of general knowledge as the schools commonly afford, there

there still remains much to be done to prepare them for the particulars to which they are destined; and in no one line of life is such preparation more especially requisite, than towards forming a complete seaman. There is certainly an extensive field for improvement in constructing working and managing ships to the greatest possible advantage. The safety and success of this insular empire--the wealth, health, and happiness of every individual member of it, depend much upon a due cultivation of those natural advantages we enjoy from situation, but call for further and require the utmost assistance of art. Amidst the numerous improvements now going forward in this thriving sea port, let it not be said that our wooden walls are neglected and forgot.---Permit then a sincere friend to the welfare of this town, to recommend an attempt towards establishing the following scheme.

LET us endeavour to begin with an Academy for twenty youths, who are already able to write a legible hand, are masters of common arithmetic, and are intended for sea officers, or for pilots. A building for this purpose would be very advantageously situated on the banks of the Mersey, as near to and directly facing the present channels into this port as circumstances will allow; in such a situation, the theory and practice of seamanship may be acquired with much more ease and to a far greater degree of perfection, than by any method hitherto adopted. What is now a task and perhaps an arduous one to many, may hereby be rendered not only easy but a pleasure both to the master and scholar. They will here enjoy the superior advantages of seeing and observing without interruption, many thousands of vessels, of various nations, different in their construction, rigging and burden, from a thousand tons downwards, conducted to and from sea, through the many difficult, dangerous, narrow, shifting, channels, amidst the numerous and extensive sand banks, as may be seen in the Chart of our Harbour, which interrupts the entrance into it, and where rapid cross tides run, even in the River, which require the most perfect skill of the Pilots, in conducting ships through so many perils with safety, according to their draught of water, and the state of the tides, over our shoal bars, where the waves of the sea often run high, all which require the utmost exertions of the ships officers and their crews, to get the necessary duty done as occasions point out.

THE good or bad consequences attending the different modes of management, may here be noted by the tutor, and pointed out to the pupils. He may illustrate what is passing before their eyes,

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ON MARITIME ACADEMIES.

and if any new and useful hints in the conduct of these ships, that vary from, and may add further improvement to the rules published on Practical Seamanship, they ought to be particularly noticed and made public, to make them as perfect as possible.

AFTER about three years study in the Academy, an apprenticeship in the merchant's service, or in that of a pilot, will be the best mode of finishing the education of a seaman.---Practice makes perfect; the more difficult and dangerous, the navigation they are accustomed to, the more expert and dexterous will our seamen become. In rapid crofs tideways, and narrow channels, the skilful sailor not only gives security to his own ship, but is enabled in a thousand instances, to hurl destruction on his country's foes.

THE patronage of some gentlemen of weight and consequence would be peculiarly serviceable, to recommend, protect and encourage this useful plan. If a beginning was once made and the inhabitants of this flourishing port thereby led to consider the subject with attention, the utility and necessity of such a seminary would so clearly appear as to secure its further progres.

SUCH preparations have already been made, that a regular plan may be easily formed from them, if the hints, now submitted to general notice, are judged deserving of public encouragement.

IN travelling through *France*, in 1749, their ambitious views might easily be seen, by their endeavours to spirit up their people; I observed several stone pillars were erected with a Globe on their tops, with the *French Arms* painted all over them. And that famous Stone Statue at *Paris*, representing *Louis the 14th*, with the four quarters of our Globe in Human Figures chained to his Pedestal, caused me to enter into an Antigallican Society in *London*; since that time they have been taking all unfair advantages against us, by seducing the other great Maritime powers to join them, by which we lost our *American Colonies*, and the immense expence they have been at, and still continue carrying on, to make an Artificial Harbour at *Cherburg*, big enough to hold their whole Navy, opposite to the *Isle of Wight*, to all appearance is designed against us.

ALL these reasons, I hope will prove the necessity there is to have Maritime Academies in all the principal sea ports in *Britain*, and especially where the most essential parts of Practical Seamanship can be seen, in the working and managing of ships through dangerous narrow channels and crofs tide ways, as has been mentioned

mentioned at *Liverpool*, where I have been long endeavouring to get one established, and according to my circumstances would gladly contribute something handsome towards getting it forward. I have wrote several pages of hints which I think might be useful towards its regulations, but it would answer no purpose to publish them till they come into use, which I hope will be soon.

I ALSO take the liberty to recommend another at *North Shields*, where the upper Light-House stands, where the extraordinary dexterous management of the coal ships going out and in, as mentioned page 130, is to be seen.

AND another at *Lime-House, London*, where not only these coal ships, but vast numbers of fine capital merchant's ships might be seen navigating close past this Academy, up and down the river, turning to windward in very little room, and where there is not room to turn to windward, drive with the tide against the wind through the shoal and narrow part of *Deptford Reach*, and in the *Pool* through greater crowds of ships, than is to be seen in any other part of the world, and all the most essential practice in the management of ships driving against the wind in very little room, which certainly makes such situations as these mentioned to learn the art of Seamanship, much preferable to that of *Chelsea* where neither ships nor sea is to be seen.

THESE hints being given towards preserving the health of seamen's bodies, I hope to be excused taking the liberty, from experience and observation, to offer some hints that may contribute to preserve the health of their souls, which have to govern and conduct their bodies through all temptations and troubles they are liable to in their passage through this our world, where we are placed in a wonderful order as probationers for a limited uncertain time, and as head and supreme actors therein; not only to be beholders and observers of all the glorious works and infinite wisdom of the ALMIGHTY's creation in and about us as men, as mentioned page 120, how our world with its necessary attending moon his kept revolving mysteriously in such exact order as to produce regularly days and nights and different seasons for the productions of the vegetable and animal creation, so bountifully

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tifully for the use, but not for the abuse of men, but that we might attribute as justly due, all the prayer, praise, adoration and thanksgiving we are capable of, by using our utmost endeavours to fear, honour, and love GOD, by keeping his commandments according to christian principles and precepts as recommended in the following Conclusion.

I shall now at the Conclusion, beg leave to propose one farther consideration to the serious attention of my Brother Seamen, however unsuitable it may appear to a subject of this kind, or to the profession or qualifications of the writer. I could wish to impress upon their minds a deep conviction of this great truth, that our own utmost skill, caution, vigilance, and dexterity, are altogether insufficient of themselves to command success in our proceedings, or preserve us from the many dangers and difficulties we are exposed to, without HIS all powerful protection and assistance, whome the winds and waves obey.----*Unless the Lord keep the house (or Ship,) the Watchman waketh but in vain.*----It is the Almighty Author of nature alone, who form'd the universe, and is present to all the parts of it, urging or restraining the elements, promoting or obstructing the designs of men according to the allwise and beneficent purposes of his government, upon whom our success, happiness and preservation intirely depend.

How diligently then should we study and endeavour, by the usefulness and piety of our lives, to recommend our selves to his favour and protection, and religiously implore his direction and assistance in all our undertakings;---knowing him to be our only *true guide, our only certain help in time of need.*

AND we may be likewise assured, that it is the persuasion alone, and the consciousness of having endeavoured to regulate our lives according to his divine Will, that can afford rational happiness in the most prosperous circumstances, or inspire us with true courage and conduct in dangers and difficulties.

THE virtuous and religious man, confiding in his GOD, will, when his duty calls, face Death itself undismayed, having nothing to fear, but much to hope from it;---whilst the impious and wicked upon the first appearance of danger are often struck with such panics, as incapacitate them for acting properly for their own safety, or that of others, which may unfortunately depend upon their courage and conduct.

IT would be needless to enumerate in confirmation of this truth, the examples, with which history both ancient and modern abounds,

bounds, as almost every one's own experience will abundantly supply them.—Indeed in the seafaring life they occur but too frequently, and afford us convincing evidence of the truth of those texts of scripture, “that there is no peace in the wicked, who are “like the troubled sea, which cannot rest:—that they flee, when no “man pursueth, while the righteous are bold as a lion.”—

BUT though our present as well as future safety and happiness so much depend upon a good, useful, and holy life, yet such is our desperate and amazing depravity, that instead of rendering due honour and adoration to the Divine Being for his manifold gracious deliverances;—instead of invoking his assistance in dangers and difficulties, how often do we ungratefully blaspheme his all sacred name by profane cursing and swearing.

How strange it is that Sailors, whose preservation so visibly depends upon the providential care, which they almost daily experience,—who are, as it may be justly said, but an inch breadth from eternity;—that they, more than any other class of men, should be almost perpetually daring the Divine vengeance by this most unaccountable vice? A vice of all others most irrational, which

[†] The most striking proof I ever met with of this was in a tyrannical, impious, self-sufficient commander of a ship in the *Jamaica* trade, under whom I failed; who openly made a mock of all religion, professing in his conversation, that he was under no concern about it; that with a conscience (as he termed it) void of offence, a man might make himself very easy, and the like. But so far was he from this happy state, that to extinguish thought and reflection, he was almost constantly adding more guilt to his painful and troubled mind, which made him visibly a Hell to himself, and the ship like a Hell a float to all on board under his command; spending his time at sea mostly in excessive drinking, gaming, quarrelling, abusing, and ill-using some part of his crew, even to breaking limbs, and endangering their lives. At the first of the voyage the officers that refused to join him in his follies were called mean spirited fellows, &c. and ordered up to the mail-head in rainy weather, for a punishment, to look-out during his pleasure.

He would damn an officer, and ask why he did not give the seamen sugar plums, only for calling them by their proper names. He deemed it an act of piracy for the officers of the watch to offer to lower or take in sail, or bear away from the course in heavy squalls of wind, though in the open ocean, and necessity might require it for the safety of the whole, but he must be called upon deck to take the command; and being commonly pot valiant, rather than be obliged to lower or take in sail, in squalls upon a wind, would run and run the ship right before the wind, and carry sail till she was so overpressed, as to lose power of the helm to command her.

Thus this over-bearing self-sufficient Hero thought to outlive all the power of storms, difficulties, and dangers without damage; but it proved otherwise, for we met with such, and so many, difficulties, that once the general outcry of the seamen was to cut boats and quit the ship; when this boasting Hero was desired to exert his authority to stop the people from it, he then tyrant like, lost all his boasted courage, fell a crying like a child, and begged his officers to take the command and stop the seamen's proceeding, which just saved the ship, but not without great damage.

We were well armed for war against the declared enemies of our country, but our commander had the worst of enemies, a guilty conscience, within himself; for when quarrelling with one part of his officers, the other were called up from sleep in the night, to get the small arms fired off and secured, to prevent, as he said, the ship being taken from him.

It would be too much to relate the many great troubles this unhappy man brought upon himself in this voyage; and the next was his last, for he was never heard of after he departed from home.—I have been prolix upon this miserable character, that it may be a warning to others, who wish for success and happiness, not to follow his example.

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which can offer neither pleasure nor profit to tempt us to the commission of it, nor urge in its vindication, what some other vices may, a natural propensity : " For no man, as Archbishop *Tillotson* justly observes, " can plead that he was born with a swearing constitution."

OFFICERS sometimes justify this wicked practice under a pretence that their orders would not be sufficiently regarded, unless enforced by swearing.---Idle and vain pretence ! as upon trying a different conduct, I am persuaded, they will be soon convinced.---From my own observation and experience I can assert, that in critical emergencies, when the least delay would be fatal to the whole, and necessity requires every one to exert his utmost, any sort of sharp words or threats uttered with an angry tone,* telling the men the necessity for their activity, and how much depends upon it, will have a better effect than vulgar oaths, which from being so frequently heard become no more regarded by them than common words ;---they having from example and daily practice learned to swear as profanely as their officers.

THE shameful prevalence of this vice amongst us, and the infectious influences of ill example, are but two evidently seen from this, that the inferior sort of foreigners, who have much conversation with us, generally acquire this common swearing part of our language first :---A melancholy proof that they hear it most frequently,---and are perhaps most inclined to imitate it.

How highly incumbent then is it upon officers and those in command always to discountenance this vicious practice by their own example; as no reformation without this can be expected;---especially if they reflect that the more exalted a man's station is, the greater his crime ; as its influence is more pernicious : And since many a fruitful and flourishing land has been made barren for the wickedness of its inhabitants, every impious and profane man ought to be deemed and treated as the greatest enemy to his country.

BUT I indulge the pleasing hope, that a reformation will now be soon produced by the virtues of our present most amiable Sovereign, in whose bright example we see piety, morality, and obedience to the laws of GOD and his country strongly recommended.---And I would hope, that his wishes expressed in his first most excellent Proclamation, are not only publickly read in all his navy, as often as the articles of war, but also enforced, to check the immorality and profaneness, which has too long prevailed amongst seamen, of all ranks and degrees.

* Calling them inactive lubbers, and the like.

AND

AND in order to promote this good end, which every one, who has the interest of his country at heart, will endeavour as much as lies in his power, I would earnestly recommend it to all commanders of ships to have a reasonable part of Divine Worship publickly performed on board every day, or as often as conveniently may be; ---which, to our shame be it spoken, is often, even in our large † *East-India* ships, scandalously neglected.

This, I think, I can say from profitable experience, contributes greatly to produce good order, harmony, and piety on board, and check disorder, vice and immorality of every kind,---even amongst the most dissolute and ignorant in privateers, as well as merchant's ships.

No rational Being surely can want exhortation to this most reasonable and bounden duty:---For man, the only animal in the creation so distinguishingly favoured,---endowed with faculties to contemplate the glorious works of the creation, and enjoy his portion of the good things thereof with gratitude to the great Creator, and benevolence to his fellow creatures,---for man, I say, to want piety and religious veneration is worse than brutish.---For man, blest with the lights of the Gospel to direct him in his duty, to reform, improve and qualify his nature for higher enjoyments,---pointing out to him, what is most conducive both to his present and future happiness, to renounce these high privileges, and blindly wallow in sensuality---is truly monstrous.

BUT after all,---though our religion lays no restraints upon us, but such only as promote our present happiness, both as individuals and members of society,---yet such is our miserable frailty, and so many, various and powerful are the enemies and temptations we have to contend with in our course, *that of ourselves*, as we have deploreable conviction from daily experience, *we cannot but fall*.

WITH what humble gratitude then, what ardor of affection and adoration should we embrace the great *Salvation* revealed in the Gospel, procured and purchased for us at so dear a pice and in so mysterious and stupendous a manner!---and freely offered us, who

† For the first fifteen years that I was at sea, in different trades, I never saw any religious duty publicly performed on board, except that in an *East-India* ship, for two or three *Sundays*, when we drew near the *Cape of Good Hope*, we had prayers, which ceased after we passed the *Gape*.---Does not this indicate that the fear of approaching danger was the motive, and not a grateful sense of those incalant benefits, we are constantly receiving?—Indeed that great company, or their managers, are highly blamable in shamefully rating those large ships only at £29 tons, in order to evade the expence of a Clergyman, and the penalty of the law for not carrying one.---It would be well for them to consider, that acting upon christian principles is the only true policy; and that schemes upon any other principles, continually devised, for accumulation of wealth, may, and most likely will in the event, prove unto them *only an occasion of falling*.

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stand so much in need, and are so wholly unworthy of it ! What *diligence* should we use,---what holiness should we aspire after, to insure to ourselves an interest in this grand ATONING SACRIFICE ! And how devoutly should we implore the promised assistance of *his aiding and sanctifying grace* to conduct us safe through this transitory voyage of life, to a blessed and happy eternity.

LET US then, under the direction and guidance of this great AUTHOR and CAPTAIN of our SALVATION, our all glorious REDEEMER, CHRIST JESUS, pursue our course with steadiness and resolution, and fight manfully under his banner, ---looking up to him for succour in all our distresses and difficulties, who is powerful in Heaven and Earth, and will never forsake or reject those, who sincerely love and trust in him,---To whom be glory for ever. *Amen.*

F I N I S.



